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DEVELOPMENT OF ADVANCED COMPUTING TECHNOLOGY FOR OPTIMIZING THE USE OF METEOROLOGICAL DATABASES:

MERCURY EVALUATION

October 1991

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This document reports the development of the MERCURY mesoscale meteorological data fusion system between 1 October 1989 and 30 September 1990. MERCURY will function as an intelligent, autonomous software interface between the data ingestion and management facilities of a future version of the integrated meteorological system, or a similar system, and tactical decision aids that require meteorological data as input. This report describes the current state of MERCURY and the procedures being used for evaluation. It also presents representative test results obtained in the Los Angeles basin area during July 1990.

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I. Overview

The objective of the MERCURY project is the development of a software system for assimilating meteorological data for a mesoscale region from a number of sources, and fusing these data as necessary to generate reliable values for standard meteorological parameters at locations for which measurements are not available. MERCURY will assimilate data from a quality-assured, real-time database of measurements and numerical predictions maintained by the Integrated Meteorological System (IMETS) or a similar system. MERCURY's outputs will include conventional three-dimensional (3D) grids and point values of meteorological parameters, as well as qualitative descriptions of spatially-located meteorological features such as front boundaries. These outputs will serve as input to a variety of tactical decision aids (TDAs), including TDAs designed to aid a Staff Weather Officer (SWO). Use of MERCURY in both prognostic and diagnostic modes is anticipated.

An initial MERCURY prototype, MERCURY-1 was developed in 1988 in order to refine a requirements statement for MERCURY that had been developed from a consideration of the task environment (Coombs et al., 1988). The design, implementation, and evaluation of MERCURY-1 is described in U. S. Army Atmospheric Sciences Laboratory (ASL) Report CR-88-0034-4 (Fields, 1988). This report also outlines a high-level design for a second prototype, MERCURY-2, to meet an expanded set of requirements generated on the basis of experience with MERCURY-1. The architecture of MERCURY-2 is described in ASL Report CR-90-0034-1 (Fields, 1990), and its implementation is described in Fields et al. (1991), which is included in the Appendix. The present report describes the current status of MERCURY (the designation "MERCURY-2" has been discontinued), and the methods being used to evaluate its performance The development of cloud image analysis algorithms for implementation in MERCURY is described by Pfeiffer (1990).

The current MERCURY implementation is being used to provide weather and terrain data for two application systems: the AIMS intentions analysis system (Coombs et al., 1990), and the WADIF environmental effects prediction system (Eskridge, 1990). These systems provide a testbed for evaluating the software and user interface tools provided by MERCURY.

II. Weather Data Ingestion and Archiving

MERCURY ingests weather data broadcast in real time via a satellite downlink, using the Scientific Data Management (SDM) software developed by the UniData program of the University Corporation for Atmospheric Research (Campbell and Rew, 1988). Functions for ingesting cloud image data in the visible and near infrared channels obtained from the Geosynchronous Operational Environmental Satellites (GOES) have been added to the system in the last year. Full-resolution GOES images have approximately 5 km resolution at mid-latitudes, so these data are adequate for analyzing cloud cover over mesoscale region. Analysis of these images is discussed in Pfeiffer (1990).

A hardware and software upgrade that will allow MERCURY to ingest gridded numerical predictions generated by the U.S. National Weather Service, and surface and upper-air data from non-U.S. stations, is in progress. These upgrades will allow MERCURY to be used in a prognostic mode for the Continental U.S., and to be used diagnostically in any areas of the world for which adequate weather and terrain data are available.

An automated archiving system, which records all data for an indicated area that is received during a specified time interval, has also been implemented in the last year. This system allows MERCURY to build its own archival data sets. Weather data from any source can be used as a MERCURY archive, provided that it is written in the file format used by the MERCURY archiver, which is derived from the format used in the satellite transmissions received by MERCURY. An example record showing this format is included in the Appendix.

III. Geographic Information System

MERCURY employs a high-resolution geographic information system (GIS) to provide terrain elevation and land-use data for the region of interest. This system can also be used to maintain information about other aspects of the terrain, e.g. the presence of roads or buildings, and to locate objects, such as weather stations, with respect to the terrain.

A terrain elevation database for the Continental U.S. with 30 second resolution in both latitude and longitude (approximately 600 m × 900 m resolution at mid-latitudes), which was obtained from the U.S. Geological Survey, has been implemented in MERCURY in the last year. This elevation database provides the underlying coordinate grid for the GIS component of MERCURY. Implementation of a surface cover database, also obtained from the U.S. Geological Survey, is in progress. These databases will allow MERCURY to be tested at a wide range of locations, which exhibit a variety of weather patterns, in the Continental United States. Digitized terrain databases for central Germany have also been obtained, and implemented in the GIS (Coombs et al., 1990; Eskridge, 1990).

The MERCURY user - developer interface allows any data in the GIS to be displayed graphically on a console or terminal running an X-Windows, version 11 server. Functions for retrieving and displaying data for any location for which data are available have been added to the interface this year. Functions for zooming and unzooming on a region, and for overlaying multiple data types have also been added.

Graphic editors that allow the contents of the terrain elevation and land use databases to be altered by the user have also been implemented in the last year. These editors allow data for new regions to be created; hence they can be used to develop terrain data sets for regions for which digitized map data are not available. They also allow the data to be edited as necessary to update features that have changed since a map was generated. The editors will be integrated into MERCURY in the next year.

IV. Analysis System

The current MERCURY analysis algorithm generates two-dimensional terrain-following grids of standard meteorological parameters for the region of interest, as well as point values for standard parameters, cloud cover, and present weather. The grid resolution is specified by the user. The analysis algorithm employed in the current MERCURY implementation is as follows.

1. Grid points within at most one grid spacing from at least one station that has reported surface data in the last two hours are classed as "nonisolated." All other grid points are classed as "isolated."

2. Heuristics are used to identify representative reporting stations, if any are available, for the isolated stations. "Representativeness" is defined in terms of both distance, and similarity of location with respect to the surrounding terrain. The heuristics being used are listed in the Appendix.

3. Data for the isolated grid points for which representative stations are available are estimated from the data obtained at the representative stations. The functions used for this estimation step are listed in the Appendix.
4. Conventional exponentially-weighted objective analysis is used to calculate values for the nonisolated grid points, and for the isolated grid points for which no representative stations could be identified. Both the measured data and the estimated values calculated in step 3 are used as data values in this calculation.
5. Values for points not on the specified grid are estimated by exponentially-weighted averaging of the values from the four closest grid points.
6. Present weather values are taken to be those reported by the nearest reporting station.

This algorithm can provide estimates for any point in the region of interest. The quality of the estimate varies, depending on the proximity of the point to one or more reporting stations, the local terrain, and the current weather pattern.

It is expected that the performance of this algorithm can be improved substantially by developing heuristics that use cloud image data to assess representativeness. Some of the estimation functions can also be made more realistic. These issues are discussed in Sect. VI below.

V. Performance Evaluation

A self-testing algorithm has been implemented that allows MERCURY to be tested continuously, in real time, in any region for which data are available. This algorithm is as follows.

1. A region of interest and grid resolution for testing are defined by the user.
2. On every reporting cycle (each hour for the surface station reports currently ingested by MERCURY), a grid is calculated for each reporting station S, using all of the data available to the system except that reported by S. Values of all parameters for the location of station S are estimated from this grid.
3. Errors for each parameter are calculated as the difference between the estimated value for the location of S and the measured value reported by S.

This algorithm can be used with archived data, in which case error values for an interval spanning many reporting cycles can be calculated. The algorithm can also be easily modified to assess the rate of degradation of performance as data from progressively greater numbers of stations are left out of the grid and estimate calculations.

This self-testing algorithm has been run for several testing intervals in a 300×300 km^2 region surrounding the Los Angeles basin (Fields et al., 1991). The Los Angeles basin is a difficult test case, since it includes both complex mountainous terrain and seacoast. The tests were run both for MERCURY, and for an objective analysis procedure alone. The results of these tests indicate that the performance of MERCURY is substantially better than the performance of objective analysis alone in this region. The extent to which MERCURY outperforms objective analysis alone increases as data from additional stations are left out of the calculations, indicating that the performance degradation of MERCURY is less drastic than that of objective analysis in data-sparse environments. Representative data from these tests are included in the Appendix.

Some tests have also been performed for the White Sands Missile Range (WSMR) area, using data collected by Atmospheric Sciences Laboratory personnel. The land use data used in these tests are low resolution; however, the results of the tests show that MERCURY provides some improvement over objective analysis alone.

VI. Recommendations

The current MERCURY implementation provides a working basis for developing a robust, general meteorological data interpolation system. The principal tasks that need to be pursued are as follows.

1. Complete implementation of high-resolution digitized land use database for the Continental U.S., and for other areas as data become available.
2. Implement the cloud image analysis algorithms described by Pfeiffer (1990), and integrate them into the analysis system.
3. Improve the other heuristics and estimation procedures used in the analysis system, using testing to assess improvements in performance.
4. Compare the performance of the system to that of objective analysis alone for multiple regions in the Continental U.S., over the span of a year so that all seasons will be represented.

Completion of these tasks should enable MERCURY to perform with the accuracy and reliability needed to provide adequate data to TDAs and other client systems.

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APPENDIX A. MERCURY: A HETEROGENEOUS SYSTEM FOR SPATIAL EXTRAPOLATION OF MESOSCALE METEOROLOGICAL DATA

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Abstract: MERCURY is an integrated software system for acquiring, analyzing, and extrapolating meteorological data in real time for regions a few hundred square kilometers in size. MERCURY employs a variety of data structures, including real scalars and vectors, three-dimensional models, chords, grids, and qualitative descriptions to represent its input data, and both procedural and declarative methods to represent meteorological knowledge. MERCURY employs the extrapolation method that it is designed to improve upon, mesoscale objective analysis, when it is likely to be sufficient, and supplements this method with additional heuristic and analytic methods when necessary. Initial performance comparisons indicate that MERCURY's extrapolations are better than those obtained with objective analysis alone in regions of complex terrain and surface cover. MERCURY is implemented in C, with graphics in X-windows, and runs on a Sun 3/60 workstation under Unix 4.2 bsd.

INTRODUCTION

Meteorologists are often called upon to solve a spatial extrapolation problem: given the weather conditions observed at one or a small number of locations, what are the weather conditions at some other location in the same region, for which data are not available? The weather conditions of interest when solving this problem are typically either mesoscale or smaller, i.e. have a maximum horizontal dimension of a hundred kilometers or less and a duration of less than a day (Orlanski, 1975); examples include snowstorms, thunderstorms, fog, or strong winds. Such weather conditions may be influenced strongly by the local terrain; hence knowledge of the terrain, and of its likely meteorological effects, is essential for successful extrapolation. Even given such knowledge, however, the extrapolation problem is often very difficult, in part because the available data may not be representative of the location to which the extrapolation is being made. The difficulty of the problem is increased significantly when it must be solved for an unfamiliar location, with fragmentary data, and under severe time constraints, as is typically the case in emergency response situations such as hazardous materials accidents, and in military situations. Significant computer support for, and if feasible complete automation of, meteorological data extrapolation would be very beneficial in such situations.

This paper describes MERCURY, a proof-of-concept system being developed to test methods for representing meteorological and terrain data, and for performing spatial extrapolation. The fundamental requirements placed on MERCURY are that it i) accept actual meteorological data as input, ii) perform data extrapolation adequately in any geographical region, iii) be usable by a nonexpert, iv) answer queries in at most a few minutes, and v) run on a relatively inexpensive workstation (McWilliams et al., 1989). The approach that we have taken to meeting these requirements represents a compromise in which accuracy has been traded for speed: MERCURY is designed to make informed guesses, based on heuristic knowledge, in difficult cases instead of calculating an exact answer from a detailed physical model of the atmosphere. MERCURY does not, however, rely on "shallow" heuristic knowledge alone; it also employs explicit geographical information, and relatively simple analytical extrapolation methods, in situations in which these can be expected to yield useful results. This use of multiple computational techniques requires a heterogeneous architecture capable of supporting a variety of data structures and their associated operations. MERCURY thus departs significantly from conventional meteorological expert systems, which typically employ declaratively-encoded heuristics alone to forecast events of a particular type, such as thunderstorms or fog, in a particular location or type of location, and which are generally intended for interactive use by an expert forecaster (e.g. Zubrick and Riese, 1985; Swetnam, et al., 1986; Elio and De Hann, 1986; Elio et al., 1987; Jasperson et al., 1987; McArthur et al., 1987; Roberts, 1988; Dyer, 1989; Stunder and Sletten, 1989; surveyed by Moninger and Dyer, 1988; Moninger et al., 1989). MERCURY is somewhat similar to the expert forecasting system of Zwack et al. (1989), which employs both heuristic and numerical techniques to predict low-altitude cloudiness.

The next section describes the task environment in which MERCURY operates. Like most scientific data analysis task environments, the MERCURY task environment is open, in the sense that the system must be able to perform adequately in an arbitrarily large set of distinct situations, most of which cannot be characterized explicitly in a specification (Hewitt, 1985; Partridge, 1987). System performance in such task environments can only be judged as adequate or inadequate by comparison with measurements of actual events; it is not possible, for example, to construct artificial test cases for a weather system. The third section describes the data and knowledge representation strategies employed in MERCURY, and the tradeoffs entailed by the use of these strategies. MERCURY employs latitude/longitude grids, real scalars and vectors, three-dimensional geometric models, spanning chords of areas, and qualitative descriptions to represent its input data, and both procedural and declarative constructs to represent meteorological knowledge. The fourth section describes the MERCURY design, and the implementation of each of the software modules. The fifth section discusses the performance of the current MERCURY system. The final section reviews the MERCURY project from the perspective of the general issue of designing intelligent systems for analyzing scientific data.

THE TASK ENVIRONMENT

Meteorological phenomena occur at a variety of spatial and temporal scales, ranging from that of long-term variations in global climate to that of transient air turbulence around individual surface features such as buildings or trees. A rough classification of the relevant scales is given in Table 1; Orlanski (1975) provides a much more detailed classification. The weather occurring at particular locations in a region may be due to phenomena at any or all of these scales; one part of a city, for example, may experience an intense thunderstorm during the passage of a low-pressure system, while another part of the same city experiences only light rain. Such local variations may be due primarily to intrinsic inhomogeneities in the larger scale system, or to the effects of the local terrain. Regional terrain features such as mountains, coastlines, deserts, or large urban areas can have strong effects on local weather under some larger-scale conditions, while having very little influence under other conditions (e.g. Retallack, 1984).

Scale	*Typical Horizontal Length Scale*	*Duration*	*Example*
Microscale	0.1 km	Minutes	Dust Devil
Mesoscale	10 km	Hours	Thunderstorm
Synoptic	100 km	Days	Low-pressure System

Table 1: Scales of meteorological phenomena relevant to the MERCURY project.

A meteorologist responsible for a region typically has access to a fixed set of instruments for measuring temperature, wind velocity, and so forth, which are located at particular positions within the region, and which obtain data for their positions at particular times. Data for a larger area containing the region, e.g. for the country or continent, may also be available. The scale of phenomena that the meteorologist will be able to observe is primarily determined by the spatial and temporal resolution of these data. The meteorologist's task consists largely of constructing a representation, either mentally, on paper, or using a computer workstation, of the present weather conditions in the region by extrapolating from the available data, and then generating predictions from this representation. The accuracy of the representation that is constructed, and of the predictions generated from it, is strongly dependent on the representativeness as well as the resolution of the data that are collected; very accurate but nonrepresentative data can lead to a completely inaccurate representation of regional weather. The quality of the representation also depends on the accuracy and robustness of the available extrapolation methods.

The standard method for constructing a representation of the weather pattern over a given region from a set of measurements is a radially-weighted, linear numerical interpolation from the available data to a regular rectangular grid (e.g. Barnes, 1964). This "objective analysis" method provides the baseline performance on which MERCURY must improve to be a useful operational system. In practice, objective analysis has two serious weaknesses, both of which are due to nonideal data resolution and representativeness. First, closeness in space is a good indicator of similarity in weather only in situations in which the weather pattern varies smoothly as a function of distance, and local effects are relatively unimportant. If the weather pattern does not satisfy these conditions, the values of the wind velocity components, in particular, calculated for grid points even relatively near one or more measurement sites may be grossly inaccurate. In any case, the values for grid points located far from any measurement sites are generally highly uncertain. Second, most objective analysis procedures represent terrain at the resolution of the interpolation grid, usually simply as an elevation value at each grid point. This procedure effectively smooths the terrain to the resolution of the grid. The interpolation is thus blind to smaller-scale terrain features, which may nonetheless have a significant effect on the weather pattern. These problems can, in principle, be solved by acquiring data at more sites and interpolating on a finer grid, as is being attempted for example in the U.S. Program for Regional Observing and Forecasting Services (PROFS), but this solution is impractical for many operational systems.

It is the responsibility of the meteorologist to judge the reasonableness of an objective analysis of a set of measurements, using knowledge of the local terrain and large scale meteorological conditions, qualitative observations of local or regional conditions, and any other available information. This requires considerable expertise, which is usually gained by experience in a particular locale. Such expertise is often very region-specific, and relatively nonportable; even experienced forecasters may require significant time to become familiar enough with a new location to perform well. These problems are exacerbated when the meteorologist is a novice, is faced with fragmentary or otherwise unreliable data, or is placed under severe time constraints in a situation, such as an emergency response, in which lives are potentially at stake. The standard approach to this problem is to provide the meteorologist with additional data, the computer resources to compute analyses over finer grids, and interactive graphic capabilities for merging or otherwise manipulating displays of data or analysis results. This solution is embodied in a number of military and civilian initiatives, including the U.S. Advanced Weather Interactive Processing System (AWIPS) effort to develop a next-generation workstation for operational forecasters. We have taken a different approach to this problem in the MERCURY project, in part because MERCURY has been specifically designed for a military application in which expertise is both scarce and expensive, and in part because all user-intensive solutions face the problem that additional data and manipulation methods can accelerate cognitive overload, and hence decrease performance, especially in critical, stressful situations. Our goal has been, therefore, to develop a system that automates as much of the expertise-requiring reasoning as possible, using the problem-solving strategies employed by meteorologists as a guide in the design of efficient heuristic extrapolation methods.

The current MERCURY system includes a graphic user interface that displays a map of the region of interest, and provides access to data and analysis results. This interface is intended both as an aid for development and testing, and as a prototype of an interface suitable for use by a novice meteorologist working in an unfamiliar region, or by a nonmeteorologist with some meteorological knowledge who needs to use meteorological data, such as an emergency-response planner. MERCURY is not an interactive system in the usual sense; it queries its user for values of a set of parameters when it begins an execution, but after that it ingests and analyzes data, and generates extrapolations autonomously. Users can query MERCURY for extrapolated data for particular points, but cannot direct MERCURY's problem solving procedures. This style of interface avoids the delays and user biases associated with user interaction in conventional expert systems, but does not provide users with any effective control over the system. Testing of MERCURY's usability by the intended users in an operational setting will be required to evaluate this interface.

DATA AND KNOWLEDGE REPRESENTATION

Our choices of data and knowledge representations to employ in MERCURY have been guided by the input-ouput requirements of the system, a desire for the representations to appear natural and familiar to a meteorologist, and the need for generality and extensibility. It became clear early in the project that a single knowledge representation strategy would not easily satisfy these guidelines. We decided, therefore, to employ the most natural representation available for each type of data or knowledge, and to develop algorithms as necessary to handle multiple representations.

A sample surface observation report of the type used by MERCURY is shown in Fig. 1. The report contains both quantitative data, e.g. values of temperature and pressure, and qualitative data, e.g. estimates of cloud type and descriptions of present weather. MERCURY's task is to produce reports of this type, and similar reports of extrapolated upper-air conditions, for locations at which data are not available. The need to generate both quantitative estimates of real-valued variables and qualitative estimates of discrete, descriptive variables requires the use of both quantitative and qualitative data representations and reasoning methods. MERCURY employs procedurally-encoded continuous-valued functions for quantitative reasoning, and declaratively-encoded heuristic rules for qualitative reasoning. Control is encoded declaratively in the analysis subsystem, which applies meteorological knowledge, and procedurally in the lower-lying data acquisition, management, and representation subsystems.

Meteorologists use many relatively simple, analytical models, often encoded by single algebraic formulae, to estimate unknown values of real-valued variables from measured values. These models are compact representations of meteorological knowledge that can be applied in particular circumstances. They are both "compiled" and "deep" in the senses defined by Chandrasekaran and Mittal (1983): knowledge encoded by such models can only be accessed for certain tasks, but both the models and the tasks they support are general enough that the knowledge has wide applicability. Models of this type can be applied directly to data encoded as real scalars or vectors to produce real-valued results; the use of such models thus avoids the need to represent continuous variables by arbitrarily selected discrete ranges, as must often be done in conventional expert systems. Moreover, because such models are used on an everyday basis by meteorologists, they satisfy the requirement of familiarity to the intended user population. A number of these models have been implemented in the MERCURY analysis subsystem (see below), either as extrapolation methods for particular variables, or to calculate values of parameters for use in qualitative reasoning.

Meteorologists make extensive use of maps, both of terrain elevation and surface cover, and of the state of the upper atmosphere. Weather prediction expert systems designed to work in particular geographic regions typically represent the local terrain implicitly, by encoding terrain effects directly in prediction heuristics. This approach is not practical in a system, such as MERCURY, intended for use in many distinct geographic regions that may have very different terrain. A more explicit approach to spatial information was taken by Elio and de Haan (1986) in the design of METEOR, which employed labeled, two-dimensional (2D) regions to represent areas - corresponding to contours - of significant cloudiness or upper-atmosphere convective activity (but not terrain) on a map. Heuristic knowledge of storm potential, represented by a set of rules, was used to predict storm severity from this spatial information. A representation of this type is feasible for terrain, but does not explicitly include the slope information needed to calculate terrain effects on, for example, wind patterns. In order to provide a more natural, higher-resolution representation of elevation, slope, and aspect, we have adopted a full three-dimensional (3D) geometric representation for both terrain and upper-atmosphere features such as low-pressure systems. In each case, the 3D representation is constructed over a gridded point representation of the data set; information about a single point can, therefore, be retrieved without having to traverse a 3D model. Models of individual terrain or atmospheric features are constructed as separate, named entities that can be accessed and manipulated as independent objects. The 3D representation has the additional advantage of being visualizable in perspective, allowing the user to gain an intuitive understanding of the shape of both the local terrain and the overlying upper-air features.

The boundaries of areas overlaid by significant terrain, and of areas with particular surface cover, are also represented by sets of endpoints of chords traversing the areas. Marine, inland lake, agricultural, forest, desert, suburban, low-density urban, and high-density urban areas are represented in this way. The chord representation allows efficient calculations of whether a point is in a named area, of the distance from a point to a named area, and of the direction from a point to the nearest boundary segment of a named area.

Heuristic rules are employed in MERCURY both to select analytical models or other rules to execute, and to perform qualitative extrapolation. The selection rules encode information about the applicability of particular approximations, models, or heuristics, and can be considered metarules (Clancey and Bock, 1988). They provide high-level declarative control in the MERCURY analysis subsystem. The extrapolation rules encode qualitative physical knowledge. Only relatively general rules of either type are used, in order to avoid having a very large knowledge base of situation- or location-specific heuristics. This strategy maintains generality, but at the cost of having no natural encoding for the local heuristics that experienced meteorologists use in particular locations. We hope to compensate for this lack by implementing methods for using information from additional data sources, such as cloud images obtained from satellites, and improved analytical models in future versions of MERCURY.

DESIGN AND IMPLEMENTATION

MERCURY comprises a set of subsystems, which perform i) data acquisition and management, ii) feature identification, 3D model generation, and area representation, iii) data analysis, iv) user interface functions, and v) automated self-testing. MERCURY has been implemented in C for speed and portability; the graphic user interface is based on X-windows (Scheifler and Gettys, 1986). MERCURY has been tested on a Sun 3/60 workstation running Unix 4.2 bsd.

Data Acquisition and Management

The data acquisition subsystem of MERCURY is shown in Fig. 2. Surface and upper-air data from the regularly-reporting National Weather Service civilian observation network in the continental U. S. are received in real time, via a communications satellite downlink, from the Domestic Data Plus (DD+) broadcast of the Zephyr Weather Information Service, Inc. of Westborough, MA. These data are ingested in real time and filtered from other, unused products in the DD+ data stream by the programs **txing** and **txdig**, which are components of the Scientific Data Management (SDM) system developed and distributed by the University Corporation for Atmospheric Research (UCAR) Unidata program (Campbell and Rew, 1988). **txing** and **txdig** run continuously in background on the workstation that serves as both the data acquisition system and the execution platform for MERCURY.

Following digestion, the data are written into hourly surface and 12-hourly upper-air data files by the programs **convert** (surface data) and **uacvt** (upper-air data), which are components of the Weather Processor (WXP) system developed by the Department of Earth and Atmospheric Sciences, Purdue University, and distributed by Unidata. **convert** is automatically invoked hourly by an execution shell that runs in background; **uacvt** is automatically invoked every 12 hours. Both the surface and upper-air data are filtered to remove errors by Zephyr Weather Services prior to the rebroadcast; no additional data quality checking is done by MERCURY.

The converted surface and upper-air data files are available for processing by the local data management software described below as soon as they are written, i.e. hourly for surface data, and 12-hourly for upper-air data. The 500 millibar (mb) height and temperature data present in the upper-air data files are automatically gridded at 230 kilometer (km) horizontal resolution by the **upcalc** program, which is a component of WXP, whenever a new upper-air data file is created. Additional data fields may be gridded; this only requires altering the automatic execution shell that controls **upcalc**. These gridded data files are also available to the local data management software when written. The gridded data are, in addition, automatically processed by the 3D model generator described below each time a new file of gridded data is written.

The MERCURY data management subsystem maintains and provides access to both the continuously-updated meteorological data files and the static terrain elevation and surface cover data files used by the MERCURY analysis subsystem. When MERCURY is executed, the user is asked to provide latitude and longitude (lat/long) coordinates of a box bounding the region of interest. The data management subsystem reads a permanent data file that specifies the lat/long locations of all U.S. weather stations from which data are available, and selects those stations that are within the region of interest. The most recent data reported by each of these stations, together with all previous data from these stations back to six hours before the current time, are read from the available meteorological data files into local surface and upper-air data files. The contents of these files are continuously updated using a first-in-first-out (FIFO) protocol as new data become available. The creation of local data files allows the maintenance of multiple reports for each local station, and greatly increases the speed with which local data may be retrieved.

The only terrain database currently implemented as part of MERCURY contains 1 km × 1 km horizontal resolution elevation data for a 100 × 100 km region of the Los Angeles, California basin area, together with digitized surface cover data created using a specialized editor. The local data management subsystem currently only provides access to these data to the analysis subsystem; once additional terrain data are available, data for the region of interest will be selected in response to a user specification of lat/long coordinates in the same way that the meteorological data are currently selected. Implementation of a digitized terrain database for the continental U.S. is currently in progress.

Feature Identification, 3D Model Generation, and Area Representation

Point values of meteorological variables or terrain characteristics, whether in isolation or in the context of a regular grid, are of limited use in much of the qualitative reasoning that is used by expert meteorologists to understand the behavior of weather patterns in complex terrain. The locations and characteristics of identified features, such as front boundaries, mountain ranges, or coastlines, are much more useful for this type of reasoning. MERCURY employs a feature detection and 3D model generation subsystem to construct 3D representations of terrain elevation and upper-air conditions It uses boundaries as well as the underlying point data to represent surface-cover characteristics in 2D.

The 3D model generator is based on the Electric Tinkertoys (ET) system developed by Soderlund and Pfeiffer (1989), which provides a library of functions for constructing and manipulating data structures representing geometric entites (Pfeiffer and Soderlund, 1988). It is used to build 3D geometric models of both the gridded upper-air height fields produced by **upcalc**, and the digitized terrain elevation data. The model generator includes a graphics display facility based on X-windows, which forms part of the MERCURY user interface.

The model generator is invoked automatically whenever a new gridded upper-air data file is written. 3D models are constructed using all grid points having height values above or below user specified cutoff values; this thresholding procedure produces a segmentation of the field into individual high- or low-pressure features, respectively, to be represented as objects by the modeler. The resulting models represent pressure ridges and troughs, respectively. Plots showing typical height-field models both with and without segmentation are shown in Fig 3.

The model generator is invoked to build models of significant terrain whenever MERCURY is executed with a new terrain data file. Two measures, of elevation with respect to sea level and local slope, are used to segment the terrain elevation data into regions of significant terrain; cutoff values for these measures are obtained from the user. The local slope is calculated at each grid point by calculating the cross product of the vectors linking the point to its south and east neighbors; the angle between this vector and the horizontal is the local slope. A grid point is taken to be inside a region of significant terrain if its elevation and slope values are both above the user-specified cutoff values. A plot showing significant terrain models generated from the gridded elevation data for the Los Angeles basin is shown in Fig. 4.

Boundary representations are also generated for each area overlaid by significant terrain, and for each area with identified surface cover, when MERCURY is executed with a terrain data file. A boundary is represented by the set of pairs of endpoints of all of the North-South and East-West chords spanning the area. This representation is suitable for concave as well as convex areas, and allows a rapid calculation of the size of the area.

Data Analysis

The MERCURY data analysis subsystem returns values of standard meteorological parameters - temperature, dew point, pressure, wind speed and direction, and visibility - either for a point specified by its lat/long coordinates, or for all points on a grid with user-specified horizontal resolution (default = 25 km × 25 km). A qualitative description of cloud type is also returned in response to queries for point data. A hierarchy of metarules is used to determine how these values are to be calculated, based on features of the region, and of the large-scale weather pattern. The basic decision implemented by these rules is between situations in which local effects are likely to be important in determining regional weather, and situations in which such effects are likely to be unimportant If the region contains either significant terrain features, or any marine area, the region is classified as having local effects regardless of its present weather. If a region is covered by a low-pressure system, or if any station in the region reports severe weather, the region is classified as having local effects. Otherwise the region is classified as free of local effects. The mesoscale objective analysis code OASYS developed by the U.S. Army Atmospheric Sciences Laboratory (Henmi and Kirby, 1990) is used to calculate a grid of values from the available data in regions with no local effects. OASYS is based in part on the KRISSY objective analysis system developed by the U.S. Forest Service (Fosberg and Sestak, 1986), which was initially used with MERCURY. A $(1/r^2)$ weighting is employed for both surface and upper-air analyses in OASYS. A radius of influence can be specified, as well as a minimum number of stations to affect each grid point. Upper-air analyses are improved by using a cubic-spline fit to the measured upper-air data from each station; this procedure yields a uniform spread of points in the vertical dimension. Horizontal interpolation is performed at whatever vertical levels are designated by the user. Only data from stations reporting within the last two hours are included in surface analyses; stations reporting in the last 12 hours are used for upper-air analyses. Queries for point data at a point P not on the grid are answered by linear, distance-weighted interpolation between the data values at all grid points less than or equal to one grid spacing away from P. Because the qualitative cloud type value is not gridded, this value is always returned as the same as the value for the nearest reporting station.

Both objective and heuristic extrapolation methods are used in regions classified as having local effects. Grid points more than one grid spacing away from any station that has reported data in the last two hours are first classified as isolated. MERCURY estimates data for an isolated grid point heuristically if one or more stations are available that are representative of that grid point. A station is classified as representative of a grid point if it satisfies a set of criteria, encoded by rules, that measure distance and direction to terrain features, coastlines, and upper-air weather features. Data from stations representative of a point P are corrected, using either physical models or heuristic factors, for differences between the elevation and surrounding surface cover at the station and P. The corrected data from all stations representative of P that are no more than twice as far from P as the nearest such station are averaged, with linear distance weighting, to yield the estimated data for P. Once data for all isolated points for which representative stations are available have been calculated, MERCURY executes OASYS to calculate a surface objective analysis, using both the data measured at stations reporting in the last two hours, and the estimates obtained for isolated grid points, as input to calculate data for both the remaining isolated grid points, and for the nonisolated grid points. Queries for point data are answered by distance-weighted interpolation between grid points, as in the previous case.

Because MERCURY is implemented in C, rules are encoded by if-then-else conditionals. The working memory of the rule base is a set of binary-valued flag variables that are set and passed between these conditionals. The result of executing a rule is, in many cases, the execution of one or more numerical functions, e.g. for correcting temperature data for altitude. The distinction between procedural and declarative encodings of knowledge and control is, therefore, largely a matter of interpretation by the designer in MERCURY; the distinction is not reflected in any explicit way in the software. Updating the knowledge base requires direct modification of the code in this implementation, but it has the advantage of a very straightforward relation between the rules and the numerical functions that they control.

OASYS and the smoke screen program **obskur**, which is a component of the user interface, are the only components of the MERCURY system not implemented in C; they have been left in the original FORTRAN and PASCAL, respectively. The analysis subsystem writes an input file for OASYS, and calls OASYS as an external routine; it then reads the output grid file written by OASYS as necessary to answer queries for point data. The interface with **obskur** is handled similarly, except that **obskur** is called by the user interface, not the analysis subsystem.

The analysis subsystem is in an early stage of development, with only relatively simple extrapolation methods implemented thus far. Our current effort is focussed on testing and incrementally improving the extrapolation methods, and on adding functions to allow cloud images and numerical weather predictions to be used as input.

User Interface

User interaction with MERCURY is supported by a graphic user interface implemented using X-windows. This interface supports both color and monochrome graphics displays of the region of interest, provides access to both meteorological and terrain data via interactive menus and fill-in forms, and allows user control of MERCURY via a command menu. The interface also incorporates a smoke-screen prediction program **obskur**, which demonstrates the capability of linking MERCURY directly to a client application program that requires extrapolated meteorological data. A typical interface screen is shown in Fig. 5.

The interface allows the user to display and edit parameter values from any measurement station, to scroll through stored measurements for any station, to create additional stations, and to enter data for these additional stations. The latter options are useful for porting historical data sets to MERCURY for testing purposes. Data are displayed in pop-up forms, which may be scrolled and edited directly. Edited station data are written to the relevant files by the data management subsystem. Data for stations created by the user are treated in the same way as real data by the data management component; however, such added stations are marked to distinguish them from real, and hence continuously updated, stations.

The interface also supports specialized graphic editors for creating and altering terrain elevation and land-use data. These editors require a color or grey-scale display capability.

Both allow editing of maps by a painting process, in which the mouse is used both to select elevation or land-use values from a menu, and to assign these values to either individual pixels or to areas. The assigned values are mapped from pixels to lat/long coordinates by the data management subsystem.

The smoke-screen prediction program **obskur** developed at the U.S. Army Atmospheric Sciences Laboratory has been partially ported to the interface to demonstrate the feasibility of two-way communication between MERCURY and client applications. When **obskur** is invoked from a command button on the MERCURY interface, it requests the user to select the lat/long location for which smoke-screen prediction is to be performed. **obskur** sends the lat/long coordinates of the selected location, together with the current time, to MERCURY. The MERCURY analysis subsystem calculates the values of all meteorological parameters for the location and time of interest, and returns these to **obskur**. **obskur** then calculates a downwind smoke plume from these data, and displays the result either as a triangle representing the predicted smoke plume on the map, or as a text output to the screen.

Self Testing

MERCURY includes a real-time self-testing subsystem, which may be executed continuously as data arrive. This subsystem tests MERCURY's performance in extrapolating values of surface meteorological variables to locations for which measurements are available. When invoked, the self-test system cycles once per hour through the set of stations reporting data. At each station S, it executes the analysis subsystem to calculate a set of data values for the location of S, using all available data except the data from S. The differences between the measured and calculated data for S are then written to a test log. Because self tests can be run continuously, MERCURY's performance at night and at other inconvenient times can be logged without user intervention. However, the present system does not provide adequate testing of MERCURY's performance in areas having no stations. This can currently be done only using historical data sets obtained by placing temporary measurement stations in such locations.

PERFORMANCE

MERCURY's performance in the Los Angeles basin region is currently being evaluated by comparing the magnitudes of MERCURY's extrapolation errors with those of OASYS run independently. Example results for two stations in the Los Angeles region, tested at 16:00 GTM, 8 March 1990, are shown in Table 2. While both systems suffer prediction errors, MERCURY consistently outperforms OASYS in this region.

While the performance results that have been obtained to date are from only a single region, and are not representative of all weather conditions within that region, they suggest that MERCURY is already capable of some improvements over objective analysis alone. Extended testing in different regions and seasons will be needed to determine whether this improvement is statistically significant, and to rationally refine the methods used by MERCURY.

Station	Variable	MERCURY Error	OASYS Error
LAX	Temperature	6.7%	63%
LAX	Dew Point	18%	67%
LAX	Wind Speed	0.0%	>100%
LAX	Wind Dir.	0.0%	>100%
FUL	Temperature	9.8%	28%
FUL	Dew Point	7.4%	44%
FUL	Wind Speed	36%	49%
FUL	Wind Dir.	43%	47%

Table 2: Comparison of MERCURY and OASYS errors for extrapolations of meteorological data at stations LAX (Los Angeles Airport) and FUL (Fullerton).

DISCUSSION

MERCURY is an artificial intelligence system designed to solve a complex, but relatively well-circumscribed scientific problem. Such problems share a number of characteristics:

- They are formally unspecifiable. The problems for which an AI system is needed are precisely those for which the correct answer is unknown, and for which it will not be known until the system has done its work. The only problems for which an input-output specification can be given in advance are those for which the system is unnecessary.
- The system needs to be able to work with uninterpreted physical data. The complexity, tedium, and time requirements of data interpretation are often the major motivations for automation; requiring the user to interpret the data in order to render it useful to the system is self-defeating.
- The data and the required results are very often real-valued. Reducing the data to a low-resolution discrete representation is usually unacceptable.
- The system's performance must degrade gracefully. An inaccurate answer, preferably with some estimate of the error, can nonetheless be useful; a failure to process certain data altogether because they violate some expectation is unacceptable.
- A well-defined strategy for evaluating and incrementally improving the system's performance is needed. Such a strategy will often require use of experimental data as it arrives for evaluation.

The idealized knowledge systems methodology, with its requirement that all domain knowledge be encoded in an explicit, declarative form (e.g. Hayes-Roth et al., 1983) is inadequate in task environments with these characteristics (e.g. Partridge, 1987; Fields and Dietrich, 1990), and expert systems designers are routinely warned away from such task environments (e.g. Bobrow et al., 1988). The demand for, and the potential scientific and economic consequences of, such applications are, however, very large. Methods for developing systems that will perform adequately in task environments with these characteristics are needed.

The approach we have taken in MERCURY combines elements of standard scientific computing with elements of knowledge-based AI. Viewed at the knowledge level, MERCURY is an automated tool-user; its task is to select and apply an analysis method that is appropriate to the region and data at hand. MERCURY's strategies for applying the available tools are explicitly patterned on those of an expert meteorologist. This approach has the advantage that scientific computing tools actually used by meteorologists, such as OASYS, can be incorporated directly into the system; the knowledge that these tools encode does not have to be re-represented in a different, and quite possibly less appropriate, notation to be used. Rules are used to encode strategic knowledge of how the available tools are to be used, for which the knowledge-engineering methodology and the declarative representation are very appropriate.

The use of geometric data structures, such as grids, 3D models, and area representations, is also modeled directly on the use of such representations by meteorologists. These data structures support spatial reasoning in a very natural way. While the spatial reasoning methods implemented in MERCURY thus far are relatively straightforward, they are similar in spirit to the methods for automated visualization-driven problem solving advocated by Abelson et al. (1989). As additional three dimensional information, such as 3D models of cloud masses, is introduced into MERCURY, the sophistication of these methods will increase.

We believe that heterogeneous designs such as that employed in MERCURY will prove useful for building AI systems for other scientific data analysis tasks. In particular, we expect both the explicit 3D spatial reasoning methods and the strategy of building automated users of available scientific computing tools demonstrated in MERCURY to be generally useful in building expert geographic information systems.

STATION ID	:LAX
TYPE	:SURFACE
LATITUDE (NORTH)	:33.93
LONGITUDE (WEST)	:118.40
ELEVATION (METERS)	:30.0
TIME (YYMMDDHH)	:89082916
TEMPERATURE (F)	:64.0
DEW POINT (F)	:58.0
WIND DIRECTION (DEG)	:9.0
WIND SPEED (KNOTS)	:4.0
PRESSURE (MB)	:113.20
VISIBILITY (MILES)	:2.5
CLOUD COVER {C, S, B, O}	:B
CLOUD BASE (FT)	:1300.0
PRESENT WEATHER	:F

Fig. 1: Typical surface meteorological station report, of the type used as input by MERCURY.

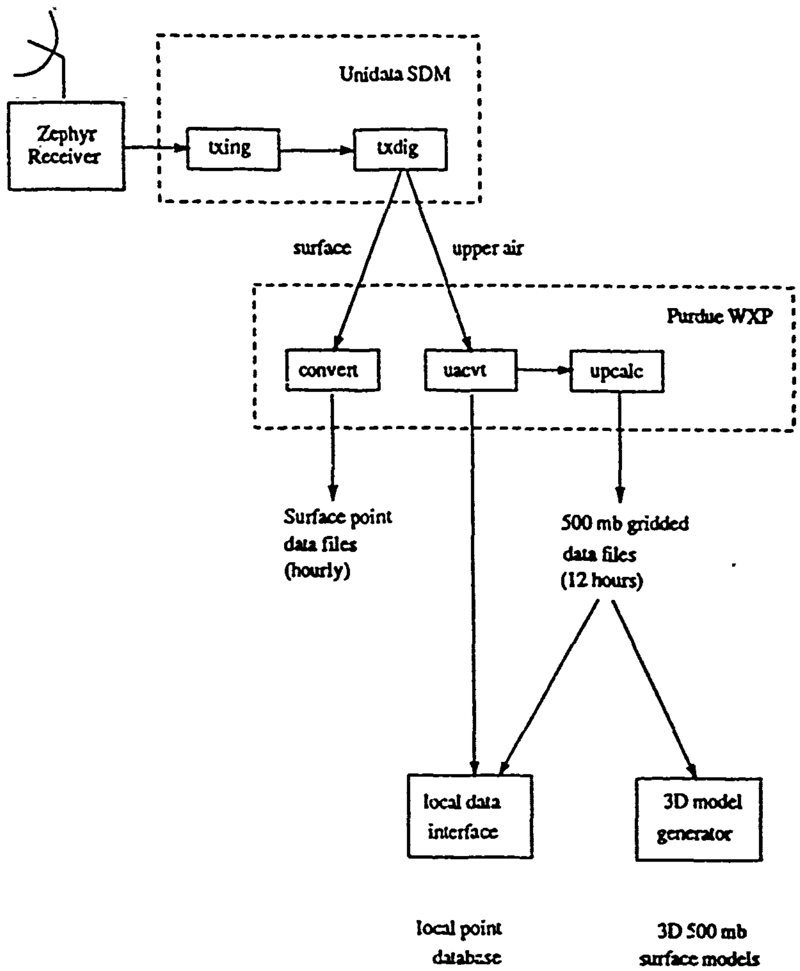

Fig. 2: Block diagram of the data acquisition system underlying MERCURY. All programs are executed automatically whenever appropriate input data are available.

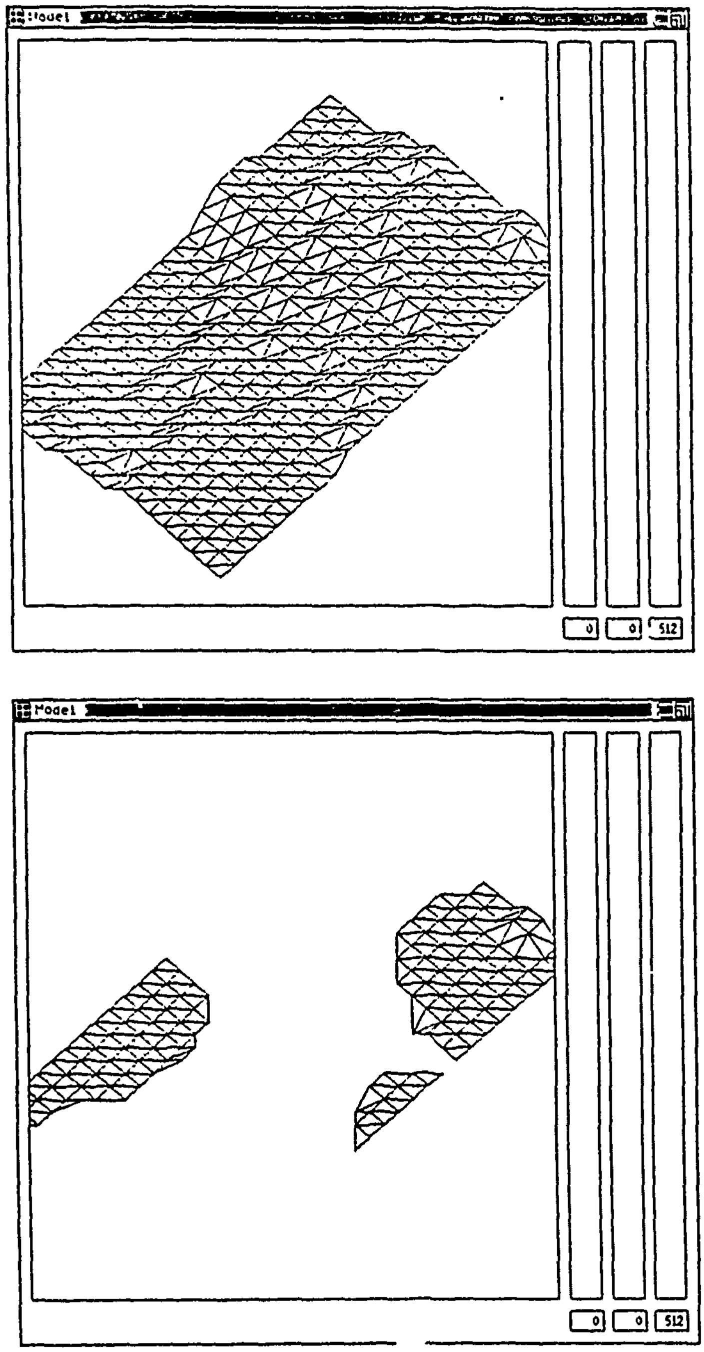

Fig. 3: (Upper) Plot showing an unsegmented model of a 500 mb height field at 230 x 230 km horizontal resolution. (Lower) Plot showing 3D models of low (left) and high (right) pressure features generated from this height field, using segmentation cutoffs of (upper level) 5800 m and (lower level) 5400 m.

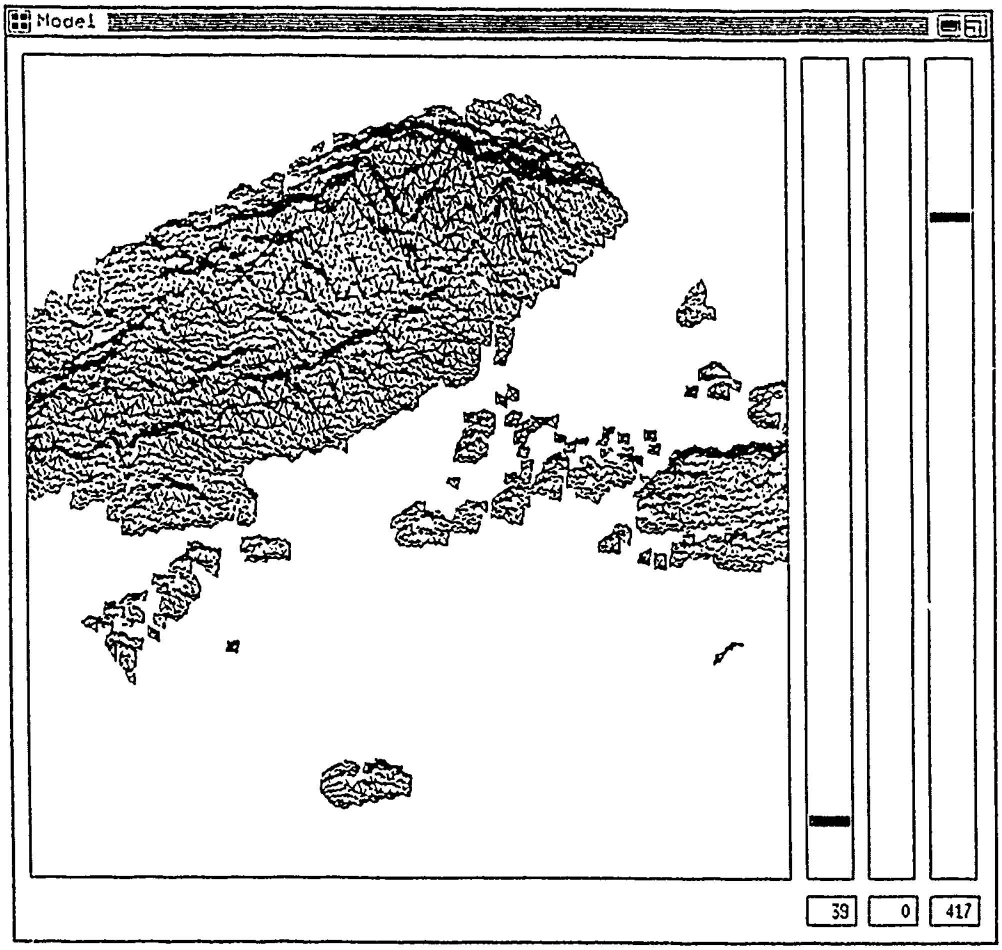

Fig. 4: Plot showing 3D significant terrain models for a 100 x 100 km region of the Los Angeles basin. The elevation cutoff value is 10 m; the slope cutoff value is 5°. The San Gabriel mountains extend across the upper part of the figure.

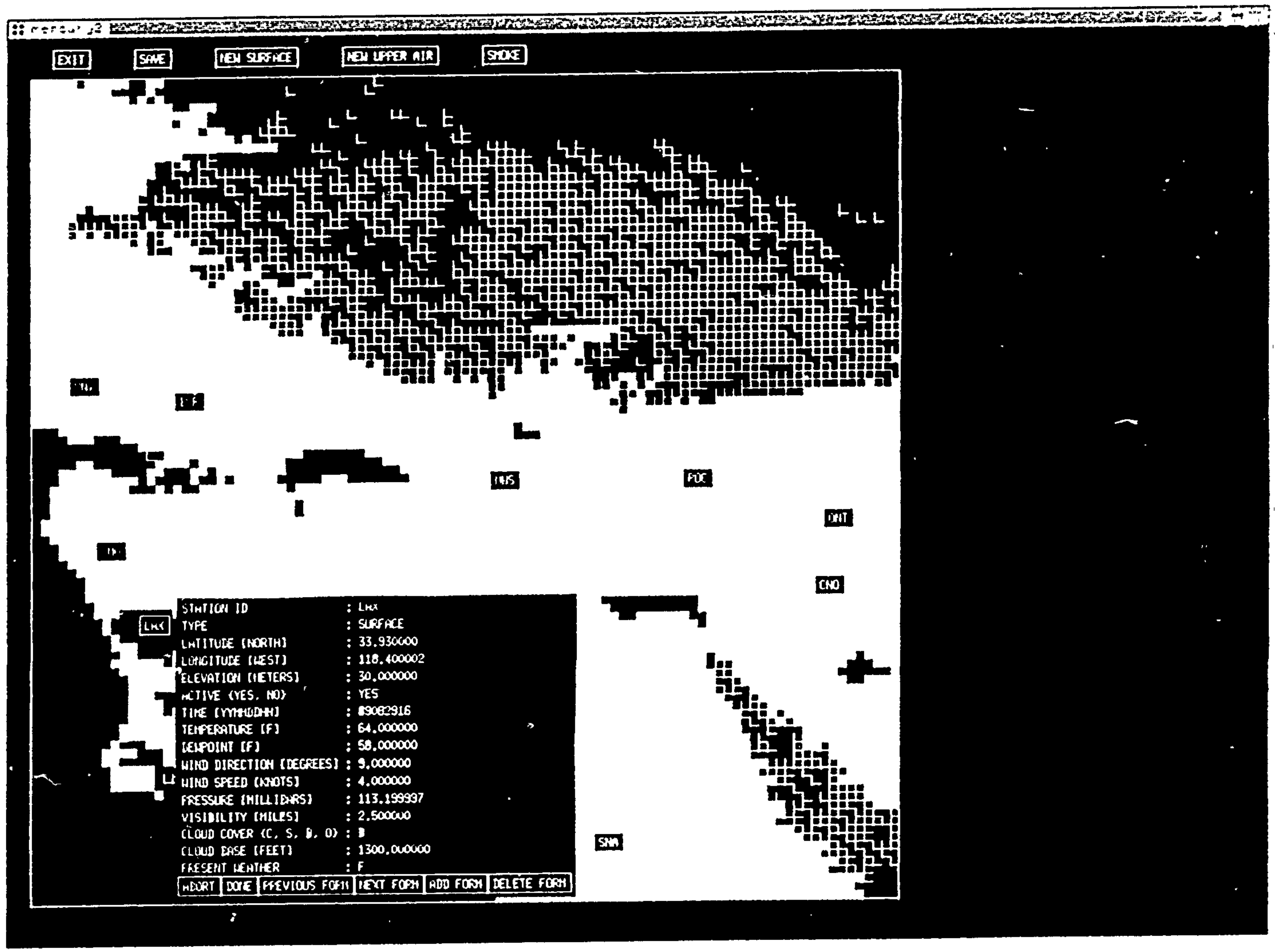

Fig. 5: Typical user interface screen, showing command menu (top panel), map display (central display area), and pop-up form for accessing and editing station data. The interface runs in a single window under the X-windows system.

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APPENDIX B. ARCHIVE FORMAT

WAS will write the weather data to the given output directory, but it wil not be in the same format as the converted input files. The WAS output format for the surface weather data is the following:

yymm.srf - file name

yy	Last two digits of the year.
mm	Month.
.srf	Three letter extension which represents surface data.

The data is group into three lines. Each format is given below.

Line 1:

sss aa.aa bbb.bb yymmddhh

sss	Station identifier.
aa.aa	Latitude
bbb.bb	Longitude
yy	Last two digits of the year.
mm	Month.
dd	Day of month.
hh	Hour of weather observation in GMT.

Example:

SDB 34.75 118.73 89040414

Line 2:

t.t d.d w.w s.s p.p v.v

t.t	Temperature in F. (-99.0 for missing)
d.d	Dewpoint in F. (-99.0 for missing)
w.w	Wind direction in degrees. (-99.0 for missing)
s.s	Wind speed in knots. (-99.0 for missing)
p.p	Pressure in millibars. (-99.0 for missing)
v.v	Visibility in miles. (-99.0 for missing)

Example:

57.0 36.0 34.0 10.0 -99.0 -99.0

Note: The numbers do not take up a specific amount of space. There will always be a space between each number.

Line 3:

c	Cloud cover (1 letter) (' ' for missing).
b.b	Cloud base (ceiling) (-99.0 for missing).
p	Present weather (may be more than one character) (' ' for missing).

Example:

Note: Cloud base does not take up a specific amount of space. There will always be a space on both sides of the cloud base.

Example WAS file follows:

```
LGB 33.81 118.15 90110100
69.00 53.00 270.00 13.00 1014.80 20.00

MWS 34.10 118.00 90110100
50.00 45.00 190.00 7.00 -99.00 -99.00

LAX 33.93 118.40 90110100
66.00 56.00 250.00 14.00 1015.40 15.00

EDW 34.90 117.87 90110100
69.00 31.00 290.00 10.00 1012.40 25.00

RIV 33.90 117.25 90110100
71.00 54.00 300.00 9.00 1014.50 10.00

EDW 34.90 117.87 90110100
69.00 31.00 290.00 10.00 1012.40 25.00

BUR 34.20 118.36 90110100
68.00 52.00 160.00 10.00 -99.00 -99.00

CRQ 33.13 117.28 90110100
-99.00 -99.00 270.00 6.00 -99.00 -99.00

EMT 34.10 118.03 90110100
-99.00 -99.00 210.00 7.00 -99.00 -99.00

ONT 34.05 117.62 90110100
```

75.00 50.00 260.00 14.00 -99.00 -99.00

PMD 34.63 118.08 90110100
-99.00 -99.00 240.00 16.00 -99.00 -99.00

POC 34.10 117.78 90110100
-99.00 -99.00 220.00 6.00 -99.00 -99.00

RAL 33.95 117.45 90110100
-99.00 -99.00 310.00 15.00 -99.00 -99.00

TOA 33.80 118.33 90110100
66.00 56.00 280.00 10.00 -99.00 -99.00

VNY 34.22 118.48 90110100
69.00 48.00 140.00 6.00 -99.00 -99.00

WJF 34.73 118.22 90110100
67.00 42.00 240.00 16.00 1013.10 40.00

NZJ 33.67 117.73 90110100
69.00 53.00 230.00 2.00 1014.10 7.00

SBD 34.10 117.23 90110100
71.00 48.00 260.00 8.00 1013.30 20.00

VCV 34.58 117.38 90110100
70.00 33.00 180.00 12.00 1011.80 20.00

APPENDIX C. REPRESENTATIVE STATION SELECTION

For each isolated point P, we find the representative stations S using the following heuristics.

IF ...

#1 : Point P and Station S are both in the same significant terrain object or both P and S are outside of all significant terrain objects.

AND

#2 : There is no point P′ between P and S with elevation(P′) > max(elevation(P), elevation(S))

AND

#3 : Point P and Station S are both in the same low pressure object or both P and S are outside of all low pressure objects.

AND

#4 : Both P and S are within 2 grid spacings from an area of marine land use or both P and S are more than 2 grid spacings from an area of marine land use.

THEN ...

Station S is representative of point P.

APPENDIX D. ESTIMATION FUNCTIONS

The following is the estimation functions used in the MERCURY analysis system for isolated point P and station S.

1. Changes due to elevation

```
The estimated temperature at P is
    temperature(P) = temperature(S) +
                     (elevation(S) - elevation(P)) / 500m * 1 degree C

The estimated pressure at P is
    pressure(P) = pressure(S) +
                  (elevation(S) - elevation(P)) / 8m * 1 millibar
```

2. Changes due to land use

```
if landuse(P) is one of {forest} and
   landuse(S) is one of {agricultural, low_urban, suburban}
then
   temperature(P) = 0.95 * temperature(S)

if landuse(P) is one of {forest} and
   landuse(S) is one of {high_urban, desert}
then
   temperature(P) = 0.90 * temperature(S)

if landuse(P) is one of {agricultural, low_urban, suburban} and
   landuse(S) is one of {high_urban, desert}
then
   temperature(P) = 0.95 * temperature(S)

if landuse(P) is one of {agricultural, low_urban, suburban} and
   landuse(S) is one of {forest}
then
   temperature(P) = 1.05 * temperature(S)

if landuse(P) is one of {high_urban, desert} and
   landuse(S) is one of {agricultural, low_urban, suburban}
then
   temperature(P) = 1.05 * temperature(S)

if landuse(P) is one of {high_urban, desert} and
   landuse(S) is one of {forest}
then
```

temperature(P) = 1.10 * temperature(S)

3. Changes for wind speed due to land use when P is outside of any significant terrain objects.

```
if landuse(P) is one of {forest} and
   landuse(S) is one of {agricultural, desert, suburban}
then
   wind_speed(P) = 0.50 * wind_speed(S)

if landuse(P) is one of {low_urban, high_urban}
   landuse(S) is one of {agricultural, desert, suburban}
then
   wind_speed(P) = 0.75 * wind_speed(S)

if landuse(P) is one of {forest} and
   landuse(S) is one of {low_urban, high_urban}
then
   wind_speed(P) = 0.75 * wind_speed(S)

if landuse(P) is one of {low_urban, high_urban}
   landuse(S) is one of {forest}
then
   wind_speed(P) = 1.25 * wind_speed(S)

if landuse(P) is one of {agricultural, desert, suburban} and
   landuse(S) is one of {forest}
then
   wind_speed(P) = 1.50 * wind_speed(S)

if landuse(P) is one of {agricultural, desert, suburban} and
   landuse(S) is one of {low_urban, high_urban}
then
   wind_speed(P) = 1.25 * wind_speed(S)
```

4. Changes in wind speed and wind direction when P is inside a significant terrain object.

[A] if no upper air data are available for the region and S is lower in altitude than P, estimate wind direction at P is eastward (Northern Hemisphere) or westward (Southern Hemisphere). Estimate wind speed as 5 m/s per 500m altitude difference, added as a vector to value from S.

[B] if upper air data are available for the region, calculate wind speed and direction at P as functions of altitude from sounding data. If more than one sounding are available, do for each sounding, then do distance weighted average of the results based on distances to the sounding stations.

```
if landuse(P) is forest
then
   wind_speed(P) = 0.75 * (estimate from [A] or [B])
```

APPENDIX E. LA BASIN TEST RESULTS

Los Angeles Basin Self Test Results

There are two columns of numbers under each category. The first is the observed reading at the NWS weather station. The second is the error between the observed reading and the analysis systems output. For example, in the first row of data, the temperature at LAX was 75.0 F. The error between 75.0 F and the output from Mercury's analysis system is -2.3 F. Therefore, the output from the analysis system was 72.7 F. A blank in the data column indicates missing data. A blank in the results columns only indicates a location for which the tested version of MERCURY produced no result, due to insufficient input.

Station	Date	Temperature		Dewpoint		Hor. Wind		Ver. Wind	
LAX	90071616	75.0	-2.3	62.0	1.9	-4.0	2.3	6.9	-5.6
LGB	90071616	72.0	0.6	64.0	-1.0	1.6	-3.9	8.9	-4.7
NUC	90071616								
NZJ	90071616	72.0	1.4	61.0	2.6	2.6	-1.9	3.1	2.2
RIV	90071616	75.0	-1.0	63.0	-0.8	1.5	-2.0	-1.3	1.4
SBD	90071616	73.0		63.0		-0.0		-0.0	
VCV	90071616	77.0		56.0		-0.0		-0.0	
BUR	90071616	73.0	-0.5	64.0	-0.9	0.0	-1.3	4.0	-2.7
CNO	90071616					-0.0	-1.8	-0.0	1.3
CRQ	90071616					5.2	-8.4	3.0	2.3
EMT	90071616					-0.0	0.4	-0.0	2.1
FUL	90071616	74.0	-1.3	63.0	0.1	1.2	-1.6	6.9	-2.9
HHR	90071616					-0.0	-4.0	-0.0	5.9
PMD	90071616					-4.0	0.3	6.9	-4.6
POC	90071616					-0.0	-1.0	-0.0	1.8
RAL	90071616					-0.0	-0.3	-0.0	0.4
SNA	90071616	73.0	-0.5	64.0	-2.3	1.2	-0.1	6.9	-2.8
TOA	90071616	70.0	3.6			-8.7	7.8	5.0	-0.8
VNY	90071616	72.0	1.2	63.0	0.8	-0.0	-1.3	-0.0	3.5
EDW	90071616	79.0		59.0		0.9	-4.9	4.9	2.0
ONT	90071616	77.0	-3.5	60.0	2.8	-3.8	3.9	1.4	-1.0
SMO	90071616	74.0	-0.3	64.0	-1.4	-4.7	2.5	1.7	2.5
WJF	90071616	78.0	1.0	52.0	7.0	-4.7	1.5	1.7	4.9
NUC	90071617								
LGB	90071617	73.0	1.0	65.0	-1.6	1.4	-2.8	7.9	-2.5
LAX	90071617	76.0	-1.0	63.0	1.5	-3.5	3.0	6.1	-0.1
NZJ	90071617	75.0	0.2	62.0	2.4	0.0	1.6	4.0	3.1
RIV	90071617	79.0	-0.5	62.0	1.0	1.7	-1.1	-1.0	1.5
SBD	90071617	78.0		64.0		-0.0		-0.0	
BUR	90071617	76.0	-0.1	63.0	-0.2	0.0	-5.0	5.0	-0.2
CNO	90071617					-0.0	4.0	-0.0	3.1

CRQ	90071617					5.0	-6.2	0.0	7.1
EMT	90071617					3.8	0.7	1.4	0.5
FUL	90071617	75.0	-0.6	63.0	1.0	-1.2	2.6	6.9	-1.9
HHR	90071617					-0.9	-1.8	4.9	1.2
ONT	90071617	80.0	-3.4	60.0	3.1	5.4	-3.8	4.5	-4.0
PMD	90071617					-1.4	1.4	3.8	-3.8
POC	90071617					8.0	-5.5	0.0	3.2
RAL	90071617					-0.0	2.1	-0.0	1.2
SMO	90071617	77.0	-1.6	65.0	-2.0	3.8	-6.6	10.3	-5.1
SNA	90071617	75.0	-0.3	65.0	-2.5	1.7	-1.5	9.8	-5.3
TOA	90071617	71.0	4.0			-6.1	5.4	3.5	2.8
VNY	90071617	76.0	-0.0	62.0	1.4	-9.4	9.6	3.4	2.3
EDW	90071617	83.0		59.0		-0.0	-1.4	-0.0	3.8
VCV	90071617	81.0		58.0		-0.0		-0.0	
WJF	90071617								
LGB	90071618	75.0	0.4	64.0	-1.6	0.0	-0.5	5.0	-3.0
LAX	90071618	76.0	-0.2	63.0	1.1	11.8	-11.8	2.1	0.0
RIV	90071618	84.0	-0.7	62.0	1.0	4.3	1.0	-2.5	1.2
EDW	90071618	88.0		57.0		2.6	-3.9	3.1	0.7
BUR	90071618								
CNO	90071618					-0.0	4.7	-0.0	2.7
CRQ	90071618					4.5	-3.1	5.4	-1.9
EMT	90071618					2.5	-1.0	4.3	-1.8
FUL	90071618	76.0	0.5	63.0	-1.1	-0.0	1.2	-0.0	3.4
HHR	90071618					-0.0	6.3	-0.0	2.9
ONT	90071618	84.0	-4.5	60.0	1.3	5.1	-3.2	6.1	-6.7
PMD	90071618					5.9	-3.3	-1.0	4.1
POC	90071618					4.3	-1.8	-2.5	5.5
RAL	90071618					7.8	-5.0	-4.5	5.2
SMO	90071618	77.0	-1.1	65.0	-2.4	4.0	0.8	6.9	-4.3
SNA	90071618	76.0	3.0	64.0	-1.0	0.0	-0.4	10.0	-8.2
TOA	90071618	73.0	2.9			-8.9	12.0	1.6	1.2
VNY	90071618	78.0	-1.8	63.0	-0.1	0.0	3.3	10.0	-6.1
NUC	90071618								
NZJ	90071618	81.0	-4.5	63.0	0.6	-0.7	1.7	1.9	4.0
SBD	90071618	83.0		64.0		4.0		0.0	
VCV	90071618	84.0		57.0		0.8		-0.6	
MWS	90071618	76.0	1.1	54.0	8.9	1.5	1.0	2.6	1.5
WJF	90071618								
NUC	90071619								
NZJ	90071619	81.0	-2.4	63.0	1.5	-0.7	3.9	1.9	5.8
VCV	90071619	84.0		57.0		0.8		-0.6	
MWS	90071619	76.0	3.9	54.0	9.2	1.5	2.2	2.6	-1.1
LAX	90071619	77.0	0.4	63.0	1.0	7.5	-7.7	2.7	-0.2
LGB	90071619	76.0	1.4	64.0	-1.1	2.7	-3.5	7.5	-4.0
EDW	90071619	93.0		56.0		3.9	-3.9	4.6	-4.6
RIV	90071619	87.0	0.5	62.0	2.0	6.9	-0.5	-4.0	2.5

SBD	90071619	87.0		65.0		4.9		-0.9	
BUR	90071619	84.0	-4.7	63.0	-0.9	-3.8	4.9	3.2	-1.2
CNO	90071619					6.9	-0.6	4.0	-4.1
CRQ	90071619					9.8	-8.9	1.7	3.2
EMT	90071619					3.8	-2.2	1.4	1.2
FUL	90071619	78.0	-0.1	64.0	-1.9	0.7	1.8	3.9	0.2
HHR	90071619					-0.0	3.6	-0.0	3.7
ONT	90071619	89.0	-7.6	61.0	0.8	8.0	-2.2	0.0	2.0
PMD	90071619					-0.0	1.5	-0.0	-1.4
POC	90071619					5.0	-0.1	0.0	2.0
RAL	90071619					6.9	-0.7	-4.0	4.4
SMO	90071619	77.0	1.3	65.0	-2.4	3.1	-0.8	8.5	-6.3
SNA	90071619	78.0	1.9	65.0	-1.8	2.1	-1.6	11.8	-8.9
TOA	90071619	76.0	1.2			-9.4	12.0	3.4	0.1
VNY	90071619	81.0	0.7	62.0	1.0	-0.0	-1.4	-0.0	3.7
WJF	90071619	90.0	3.0	50.0	6.0	1.0	-0.4	-2.8	3.6
MWS	90071620	76.0	4.8	54.0	9.1	1.5	2.4	2.6	0.6
LGB	90071620	78.0	-0.8	64.0	-1.4	4.6	-3.2	3.9	0.0
LAX	90071620	76.0	2.0	63.0	0.9	8.5	-2.9	3.1	-0.6
NZJ	90071620	79.0	0.1	63.0	1.4	8.0	-4.2	0.0	7.9
RIV	90071620	90.0	-1.2	63.0	1.2	6.9	-0.3	-1.2	-0.4
SBD	90071620	88.0		65.0		2.0		0.0	
VCV	90071620	92.0		54.0		1.7		-1.0	
BUR	90071620	84.0	-2.7	63.0	-0.9	-3.0	5.2	5.2	-3.2
CNO	90071620					8.7	0.7	5.0	-2.8
CRQ	90071620					6.1	-5.1	-3.5	8.4
EMT	90071620					3.8	-2.2	3.2	-0.6
FUL	90071620	79.0	-0.7	63.0	-0.8	0.0	4.7	6.0	-2.4
HHR	90071620					9.0	-4.3	0.0	3.7
ONT	90071620	91.0	-9.0	62.0	-0.2	13.2	-6.3	4.8	-2.4
PMD	90071620					5.2	-0.4	-3.0	2.2
POC	90071620					5.0	2.0	0.0	3.7
RAL	90071620					7.7	0.2	-6.4	8.9
SMO	90071620	78.0	0.2	65.0	-2.4	5.0	-0.2	8.7	-6.2
SNA	90071620	78.0	1.2	65.0	-1.9	2.1	3.5	11.8	-9.7
TOA	90071620	75.0	2.8			-7.5	13.7	2.7	0.3
VNY	90071620	84.0	-2.3	62.0	1.0	-0.0	0.0	-0.0	5.0
EDW	90071620	93.0		54.0		-0.0	5.2	-0.0	-3.0
NUC	90071620								
WJF	90071620	93.0	-3.9	52.0	2.8	5.9	-2.5	-1.0	0.2
SDB	90071620	83.0		56.0		-5.1		14.1	
LGB	90071621	78.0	0.8	64.0	-0.2	0.0	6.2	8.0	-6.0
LAX	90071621	77.0	1.4	64.0	0.5	6.4	0.7	7.7	-5.5
NZJ	90071621	80.0	-0.7	64.0	0.4	5.6	-1.4	-2.1	8.4
RIV	90071621	92.0	0.0	65.0	-0.0	7.9	0.6	-1.4	0.7
SBD	90071621	92.0		66.0		4.7		1.7	
VCV	90071621	92.0		53.0		-0.7		1.9	

BUR	90071621	85.0	-2.7	64.0	-0.5	-1.4	2.8	7.9	-1.8
CNO	90071621					9.8	0.8	1.7	-1.9
CRQ	90071621					7.0	-0.8	0.0	4.0
EMT	90071621					3.9	-1.3	4.6	-3.2
FUL	90071621	80.0	-0.7	63.0	1.1	6.1	-1.2	3.5	0.3
HHR	90071621					7.9	-1.9	1.4	4.1
ONT	90071621	92.0	-6.6	62.0	2.6	14.0	-5.8	0.0	0.8
PMD	90071621					1.7	3.8	9.8	0.4
POC	90071621					4.9	4.2	-0.9	2.6
RAL	90071621					9.4	-0.3	-3.4	3.8
SMO	90071621	77.0	2.4	65.0	-1.2	8.7	-4.0	5.0	0.3
TOA	90071621	78.0	0.2			7.8	-2.7	-4.5	9.8
VNY	90071621	85.0	-2.3	63.0	1.2	-2.7	4.6	7.5	-1.1
SNA	90071621	78.0	2.2	65.0	-1.3	1.7	4.0	9.8	-9.6
EDW	90071621	97.0		53.0		1.0	0.7	5.9	3.9
NUC	90071621								
WJF	90071621	94.0	-2.8	51.0	3.6	6.5	-5.6	11.3	-1.3
SDB	90071621	82.0		57.0		-6.2		16.9	
LAX	90071622	76.0	3.2	64.0	1.2	11.3	-3.8	6.5	-2.4
LGB	90071622	78.0	1.4	64.0	-0.3	0.0	7.0	10.0	-7.5
NZJ	90071622	81.0	-1.5	63.0	0.6	8.0	-4.0	0.0	5.9
EDW	90071622	100.0		55.0		0.0	1.7	6.0	3.8
NUC	90071622								
RIV	90071622	92.0	0.3	65.0	-1.0	9.4	2.8	-3.4	2.1
SBD	90071622	92.0		65.0		8.0		0.0	
VCV	90071622	94.0		53.0		0.0		5.0	
BUR	90071622	85.0	-2.6	64.0	-0.3	-1.7	1.7	9.8	-3.9
CNO	90071622					14.1	-1.9	5.1	-4.2
CRQ	90071622					6.9	0.5	4.0	1.1
EMT	90071622					3.0	1.1	5.2	-3.6
FUL	90071622	81.0	-1.4	63.0	0.7	4.5	1.3	5.4	-0.7
HHR	90071622					9.4	-0.6	3.4	1.7
ONT	90071622	93.0	-7.2	61.0	3.1	14.8	-3.1	2.6	-0.3
PMD	90071622					16.5	-8.3	9.5	5.7
POC	90071622					7.9	2.5	-1.4	5.0
RAL	90071622					14.1	-2.7	-5.1	6.5
SNA	90071622	78.0	3.1	64.0	-1.0	0.0	7.3	8.0	-5.9
TOA	90071622	79.0	-0.9			10.4	-4.2	-6.0	12.4
VNY	90071622	85.0	-2.2	63.0	1.4	-5.1	6.7	6.1	2.2
WJF	90071622	93.0	0.0	53.0	3.2	10.0	1.7	17.3	-7.8
SMO	90071622	78.0	1.0	66.0	-2.2	5.0	1.9	8.7	-3.3
SDB	90071622	82.0		58.0		-5.5		15.0	
VNY	90071623	85.0	-2.7	63.0	0.8	-5.1	7.1	6.1	-1.2
LAX	90071623	75.0	3.0	64.0	1.9	9.5	-1.2	5.5	-2.4
LGB	90071623	79.0	-0.7	65.0	-1.2	0.0	6.7	12.0	-8.4
NZJ	90071623	78.0	1.5	63.0	0.7	9.0	-4.9	0.0	9.7
RIV	90071623	92.0	1.3	66.0	-1.3	11.3	1.8	-6.5	3.4

VCV	90071623	93.0		55.0		-1.7		9.8	
BUR	90071623	85.0	-3.0	63.0	0.9	-1.7	2.0	4.7	1.3
CRQ	90071623					7.9	-0.3	1.4	3.9
FUL	90071623	80.0	-0.6	63.0	1.2	4.0	1.8	6.9	-0.9
HHR	90071623					9.8	-1.9	1.7	3.2
ONT	90071623	94.0	-8.7	61.0	3.5	15.0	-2.9	0.0	0.8
PMD	90071623					14.6	-2.7	12.2	5.5
SMO	90071623	76.0	2.4	67.0	-3.3	8.4	-2.3	7.1	-2.6
SNA	90071623	78.0	1.2	64.0	-0.8	0.0	7.7	15.0	-12.6
TOA	90071623	78.0	-0.3			9.4	-3.3	-3.4	9.6
WJF	90071623	92.0	-0.5	53.0	4.0	12.0	0.4	20.8	-9.8
EDW	90071623	100.0		57.0		11.3	3.3	4.1	8.1
SBD	90071623	93.0		66.0		6.6		-2.4	
CNO	90071623					14.8	-2.2	2.6	-3.2
EMT	90071623					1.7	1.7	9.8	-8.3
POC	90071623					6.6	4.0	-2.4	5.7
RAL	90071623					16.9	-5.0	-6.2	5.3
NUC	90071623								
SDB	90071623	78.0		57.0		-2.3		12.8	
LGB	90071700	79.0	-2.6	65.0	-2.3	0.0	8.2	10.0	-5.3
LAX	90071700	74.0	2.3	64.0	0.6	12.1	-1.3	7.0	-3.4
NZJ	90071700	77.0	2.1	62.0	1.6	8.9	0.2	-1.6	10.7
RIV	90071700	90.0	1.3	65.0	-1.3	10.3	3.5	-3.8	5.0
SBD	90071700	91.0		65.0		8.0		0.0	
VCV	90071700	93.0		54.0		0.0		10.0	
BUR	90071700	84.0	-2.5	63.0	-1.8	-2.7	5.8	7.5	-2.3
CNO	90071700					14.1	-2.0	5.1	-1.1
CRQ	90071700					5.9	4.6	-1.0	6.6
EMT	90071700					1.7	1.0	9.8	-5.4
FUL	90071700	78.0	-0.3	63.0	-0.6	0.0	7.1	10.0	-3.9
HHR	90071700					11.8	-1.3	2.1	3.9
ONT	90071700	92.0	-10.7	60.0	2.1	14.1	-2.4	5.1	-1.0
PMD	90071700					16.7	-1.4	19.9	-3.0
POC	90071700					6.9	1.9	4.0	1.8
RAL	90071700					18.0	-6.7	0.0	2.3
SMO	90071700	74.0	3.4	66.0	-3.0	13.9	-6.0	8.0	-2.6
SNA	90071700	78.0	0.1	64.0	-1.5	9.6	-2.6	11.5	-9.0
TOA	90071700	76.0	0.8			13.8	-6.0	-2.4	8.8
VNY	90071700	86.0	-5.3	60.0	3.3	-2.5	5.1	4.3	2.6
WJF	90071700	90.0	-1.1	53.0	5.2	16.1	-1.9	19.2	-2.2
EDW	90071700	97.0		59.0		12.1	4.6	7.0	12.9
NUC	90071700								
MWS	90071700	72.0	8.5	55.0	8.0	2.5	-0.4	4.3	5.2
SDB	90071700	76.0		57.0		-1.7		9.8	
NUC	90071701								
MWS	90071701	72.0	6.6	55.0	8.2	2.5	2.6	4.3	4.1
LAX	90071701	72.0	3.1	64.0	0.0	10.8	-1.7	1.9	1.8

LGB	90071701	80.0	-5.9	65.0	-2.2	7.9	-1.4	-1.4	5.9
NZJ	90071701	77.0	0.2	63.0	0.7	-2.1	8.0	5.6	1.2
RIV	90071701	86.0	2.0	64.0	-1.5	9.5	2.7	-5.5	5.0
VCV	90071701	90.0		54.0		0.0		15.0	
BUR	90071701	81.0	-0.4	64.0	-2.9	-2.7	5.1	7.5	-2.5
CRQ	90071701					6.1	5.2	3.5	-1.1
FUL	90071701	76.0	0.9	63.0	-0.5	0.0	7.3	8.0	-4.2
HHR	90071701					8.9	1.0	1.6	1.3
ONT	90071701	88.0	-8.6	61.0	0.6	12.2	0.2	4.4	-0.0
PMD	90071701					12.5	-1.3	21.6	-4.2
POC	90071701					6.9	1.9	5.8	-0.8
SMO	90071701	74.0	1.4	65.0	-1.9	13.0	-6.1	10.9	-8.1
SNA	90071701	76.0	1.4	64.0	-0.8	3.4	-1.2	9.4	-4.5
TOA	90071701	72.0	4.0			12.0	-4.1	0.0	2.8
VNY	90071701	85.0	-6.6	60.0	3.8	-3.9	6.2	4.6	2.4
WJF	90071701	88.0	-1.8	54.0	4.4	11.0	0.6	19.1	-0.4
EDW	90071701	94.0		60.0		12.3	0.2	10.3	11.4
SBD	90071701	88.0		63.0		7.9		1.4	
CNO	90071701					16.9	-6.9	6.2	-3.0
EMT	90071701					5.0	-2.2	8.7	-4.3
RAL	90071701					14.1	-3.1	-5.1	7.8
SDB	90071701	74.0		56.0		3.4		9.4	
NUC	90071702								
MWS	90071702	72.0	4.3	55.0	8.6	2.5	1.6	4.3	-1.1
LGB	90071702	77.0	-3.9	65.0	-2.2	7.9	-0.8	-1.4	3.3
LAX	90071702	71.0	2.1	64.0	0.3	12.1	-3.2	7.0	-5.3
NZJ	90071702	75.0	1.5	63.0	0.7	3.8	2.9	1.4	4.7
RIV	90071702	82.0	2.7	63.0	0.2	7.8	4.0	-4.5	4.6
VCV	90071702	85.0		56.0		-4.8		13.2	
EDW	90071702	89.0		60.0		10.4	2.1	6.0	15.7
BUR	90071702	78.0	-1.1	65.0	-2.0	-2.7	5.1	7.5	-3.3
CNO	90071702					9.4	1.8	3.4	-1.6
CRQ	90071702					4.7	6.2	1.7	-1.3
EMT	90071702					3.8	-1.0	3.2	1.1
FUL	90071702	75.0	0.2	63.0	-0.5	1.4	6.2	7.9	-5.9
HHR	90071702					9.8	0.4	1.7	2.1
ONT	90071702	84.0	-6.3	61.0	0.7	12.8	-3.6	2.3	0.4
PMD	90071702					14.7	-2.3	8.5	5.1
POC	90071702					9.4	-1.5	3.4	-0.3
RAL	90071702					16.7	-7.9	-3.0	4.3
SMO	90071702	72.0	1.6	65.0	-1.3	9.5	-1.9	5.5	-1.3
SNA	90071702	76.0	-0.6	64.0	-0.8	5.0	0.2	8.7	-6.8
TOA	90071702	71.0	3.1			11.5	-3.1	-9.6	13.1
VNY	90071702	80.0	-4.1	63.0	1.5	-3.0	4.9	5.2	0.8
WJF	90071702	85.0	-3.0	55.0	3.1	12.9	0.0	15.3	-7.3
SBD	90071702	85.0		64.0		5.6		2.1	
SDB	90071702	71.0		55.0		2.7		7.5	

HHR	90071703					9.8	-1.9	1.7	-0.1
LAX	90071703	69.0	1.9	63.0	0.9	9.4	-1.0	3.4	-2.1
LGB	90071703	73.0	-1.7	64.0	-0.8	5.8	-0.9	-6.9	8.7
RIV	90071703	79.0	1.7	64.0	-0.3	3.8	6.9	-3.2	3.2
VCV	90071703	82.0		53.0		2.6		14.8	
BUR	90071703	73.0	0.3	65.0	-2.0	-3.4	4.8	9.4	-6.8
CNO	90071703					8.7	1.1	5.0	-2.6
CRQ	90071703					6.6	4.3	2.4	-2.0
EMT	90071703					2.5	3.5	4.3	-5.9
FUL	90071703	73.0	-0.2	63.0	0.2	-1.2	7.2	6.9	-6.5
ONT	90071703	80.0	-3.7	60.0	3.7	11.3	-2.9	4.1	-1.3
PMD	90071703					16.9	-3.9	6.2	7.8
POC	90071703					9.0	-1.6	0.0	3.7
RAL	90071703					14.8	-7.6	-2.6	4.5
SMO	90071703	70.0	0.8			9.4	-3.4	3.4	-0.7
SNA	90071703	73.0	0.2	64.0	-1.6	0.0	2.3	8.0	-7.0
TOA	90071703	70.0	1.3			7.7	-0.6	-6.4	7.7
VNY	90071703	75.0	-3.0	63.0	1.8	-3.8	4.8	3.2	3.6
WJF	90071703	81.0	-3.0	57.0	2.1	12.9	2.2	15.3	-8.7
SBD	90071703	81.0		65.0		6.0		0.0	
EDW	90071703	85.0		61.0		13.9	3.1	8.0	-1.8
NZJ	90071703	73.0	0.5	62.0	1.6	0.2	2.9	1.0	4.4
NUC	90071703								
SDB	90071703	67.0		56.0		2.7		7.5	
HHR	90071704					9.8	-1.7	1.7	-1.2
RAL	90071704					14.8	-8.0	-2.6	3.6
TOA	90071704	70.0	0.4			7.7	-0.1	-6.4	7.2
LGB	90071704	71.0	-0.0	64.0	-0.7	6.9	-1.6	-5.8	6.9
LAX	90071704	69.0	1.0	63.0	0.2	9.8	-1.7	1.7	-0.5
NZJ	90071704	71.0	1.5	62.0	2.3	1.9	2.7	0.7	4.0
RIV	90071704	76.0	2.7	65.0	-2.0	5.2	4.5	-3.0	2.6
SBD	90071704	79.0		64.0		3.0		0.0	
VCV	90071704	80.0		53.0		0.7		1.9	
BUR	90071704	72.0	-0.3	64.0	-1.0	-0.9	4.1	4.9	-4.2
CNO	90071704					6.1	4.8	3.5	-2.2
CRQ	90071704					-0.0	8.8	-0.0	-1.5
EMT	90071704					2.5	1.7	4.3	-6.1
FUL	90071704	73.0	-1.6	63.0	0.4	0.0	6.3	5.0	-4.8
ONT	90071704	78.0	-3.3	60.0	3.8	13.8	-7.5	2.4	-0.6
PMD	90071704					16.9	-6.8	6.2	4.9
POC	90071704					4.9	3.1	-0.9	3.5
SMO	90071704	69.0	1.3	63.0	0.2	6.9	0.0	4.0	-2.8
SNA	90071704	72.0	-0.4	65.0	-2.6	2.7	0.6	7.5	-7.0
VNY	90071704	73.0	-1.9	63.0	0.7	-0.0	2.2	-0.0	3.9
WJF	90071704	78.0	-2.8	57.0	2.4	10.3	3.9	12.3	-6.1
NUC	90071704								
EDW	90071704	81.0		61.0		9.5	7.4	5.5	0.7

SDB	90071704	66.0		57.0		1.2		6.9	
RAL	90071705					14.8	-9.4	-2.6	3.7
TOA	90071705	70.0	-0.5			7.7	-0.6	-6.4	7.5
CNO	90071705					6.1	2.7	3.5	-3.6
CRQ	90071705					-0.0	9.1	-0.0	-1.3
EMT	90071705					2.5	2.0	4.3	-5.5
FUL	90071705	73.0	-2.6	63.0	0.3	0.0	6.6	5.0	-4.7
POC	90071705					4.9	1.9	-0.9	2.7
SMO	90071705	69.0	0.3	63.0	0.2	6.9	-0.6	4.0	-2.8
LGB	90071705	70.0	0.7	64.0	-0.8	8.5	-3.8	-3.1	3.8
LAX	90071705	68.0	1.7	63.0	0.2	9.8	-3.9	1.7	-0.9
RIV	90071705	75.0	0.7	65.0	-2.0	3.9	4.7	-0.7	0.2
SBD	90071705	76.0		64.0		0.9		0.5	
VCV	90071705	78.0		53.0		-0.5		3.0	
EDW	90071705	80.0		61.0		9.5	4.3	5.5	6.1
BUR	90071705	71.0	-0.7	64.0	-1.0	-0.9	3.6	4.9	-4.2
ONT	90071705	75.0	-1.6	60.0	3.6	10.0	-3.7	0.0	1.8
PMD	90071705					13.8	-3.1	11.6	0.1
SNA	90071705	71.0	-0.2	65.0	-3.3	5.4	-2.0	4.5	-3.8
WJF	90071705	77.0	-2.0	56.0	2.7	10.9	1.3	13.0	-3.4
NUC	90071705								
NZJ	90071705	70.0	1.5	61.0	3.3	1.9	4.0	0.7	2.3
VNY	90071705	71.0	-0.6	63.0	0.7	-0.0	1.7	-0.0	4.1
SDB	90071705	67.0		55.0		4.7		1.7	
CNO	90071706					6.1	-2.7	3.5	-0.9
CRQ	90071706					-0.0	7.4	-0.0	0.7
EMT	90071706					2.5	-3.3	4.3	1.3
FUL	90071706	73.0	-3.4	63.0	-2.2	0.0	3.7	5.0	-3.8
POC	90071706					4.9	-2.1	-0.9	4.6
SMO	90071706	69.0	0.1	63.0	0.2	6.9	-2.0	4.0	-1.2
BUR	90071706	71.0	-0.9	64.0	-1.9	-0.9	2.9	4.9	-3.5
LGB	90071706	70.0	0.5	64.0	-2.2	4.6	-1.9	-3.9	7.6
LAX	90071706	68.0	1.5	64.0	-1.5	8.5	-3.7	3.1	0.1
RIV	90071706	73.0		65.0		2.0		0.0	
ONT	90071706	73.0	-1.8	60.0	0.3	3.8	1.0	3.2	-0.7
PMD	90071706					9.6	0.7	11.5	0.3
SNA	90071706	71.0	-0.9	65.0	-2.6	4.9	-3.4	0.9	1.0
VNY	90071706	71.0	-0.8	63.0	0.1	-0.0	1.3	-0.0	4.6
WJF	90071706	77.0	-1.9	55.0	2.9	10.9	-0.9	13.0	-4.1
EDW	90071706	79.0		61.0		7.7	2.0	6.4	5.1
NZJ	90071706	69.0	2.3	62.0	2.3	0.3	4.0	2.0	-0.6
SBD	90071706	74.0		64.0		1.9		0.7	
VCV	90071706	76.0		55.0		-2.1		5.6	
MWS	90071706	67.0	4.2	47.0	16.0	-1.0	3.6	5.9	-1.7
NUC	90071706								
SDB	90071706	69.0		53.0		16.9		-6.2	
SNA	90071707	71.0	-1.8	65.0	-2.1	4.9	-3.3	0.9	-1.7

VNY	90071707	71.0	-0.5	63.0	0.1	-0.0	-3.8	-0.0	3.1
EDW	90071707	79.0		61.0		7.7	2.0	6.4	5.1
MWS	90071707	67.0		47.0		-1.0		5.9	
NUC	90071707								
LGB	90071707	69.0	1.4	64.0	0.3	3.9	-0.3	-4.6	5.1
LAX	90071707	68.0	1.3	64.0	-1.0	6.6	-5.9	2.4	-2.7
RIV	90071707	72.0		65.0		2.0		-0.3	
SBD	90071707	73.0		64.0		-0.0		-0.0	
VCV	90071707	74.0		55.0		0.3		0.9	
BUR	90071707	71.0	-0.7	64.0	-2.1	-5.2	6.0	3.0	-2.5
ONT	90071707	72.0		59.0		3.8		3.2	
PMD	90071707					7.7	-0.0	9.2	-0.5
NZJ	90071707	69.0	1.9	63.0	1.4	0.9	3.8	-0.3	0.9
WJF	90071707	75.0	-0.3	56.0	2.7	7.7	0.3	9.2	-2.0
SDB	90071707	68.0		55.0		11.3		-6.5	
SNA	90071708	71.0	-2.6	65.0	-2.1	4.9	-4.1	0.9	-1.5
VNY	90071708	71.0	-2.2	63.0	1.0	-0.0	-3.2	-0.0	2.5
EDW	90071708	79.0		61.0		7.7	0.1	6.4	2.8
MWS	90071708	67.0		47.0		-1.0		5.9	
LGB	90071708	69.0	1.1	64.0	0.3	3.9	-0.6	-4.6	5.2
PMD	90071708					7.7	-0.0	9.2	-0.5
LAX	90071708	68.0	0.3	64.0	-1.0	5.9	-5.9	1.0	-1.0
NZJ	90071708	68.0	2.9	63.0	1.4	-0.0	4.7	-0.0	0.4
RIV	90071708	71.0		65.0		1.0		-0.2	
SBD	90071708	72.0		64.0		-0.0		-0.0	
VCV	90071708	73.0		54.0		0.0		2.0	
BUR	90071708	69.0	1.3	65.0	-3.1	-4.3	5.0	2.5	-2.1
ONT	90071708	72.0		59.0		3.8		1.4	
NUC	90071708								
WJF	90071708	75.0	-0.7	55.0	3.3	7.7	0.7	9.2	-2.2
SDB	90071708	67.0		54.0		14.7		-8.5	
LGB	90071709	69.0	-0.7	64.0	-3.0	3.9	-3.9	-4.6	4.6
PMD	90071709					7.7	1.5	9.2	-1.5
NUC	90071709								
LAX	90071709	68.0	0.3	64.0	-3.0	6.6	-6.6	2.4	-2.4
NZJ	90071709	68.0	0.4	61.0	3.0	-0.0	5.0	-0.0	-2.5
RIV	90071709	70.0		65.0		-0.0		-0.0	
VCV	90071709	73.0		53.0		-0.7		1.9	
BUR	90071709	69.0		65.0		-0.0		-0.0	
ONT	90071709	72.0		59.0		-0.0		-0.0	
SBD	90071709	71.0		64.0		-0.0		-0.0	
WJF	90071709	74.0	-7.0	56.0	-2.0	9.2	-1.1	7.7	0.4
SDB	90071709	67.0		54.0		11.0		0.0	
NUC	90071710								
LAX	90071710	68.0	0.3	64.0	-2.0	8.0	-6.7	0.0	-0.7
NZJ	90071710	68.0	-0.3	62.0	2.0	1.7	8.3	-1.0	1.0
RIV	90071710	70.0		65.0		-0.0		-0.0	

VCV	90071710	72.0		54.0		-0.0		-0.0	
BUR	90071710	68.0		64.0		-0.0		-0.0	
ONT	90071710	71.0		59.0		-0.0		-0.0	
SBD	90071710	69.0		63.0		-0.0		-0.0	
WJF	90071710	75.0		55.0		8.4		7.1	
SDB	90071710	66.0		53.0		6.9		1.2	
LAX	90071711	68.0	0.3	64.0	-2.0	7.0	-7.0	0.0	0.0
NZJ	90071711	68.0	-0.3	62.0	2.0	-0.0	8.8	-0.0	0.0
RIV	90071711	70.0		65.0		2.0		0.0	
VCV	90071711	72.0		54.0		-0.3		2.0	
BUR	90071711	68.0		64.0		-0.0		-0.0	
ONT	90071711	69.0		59.0		3.8		1.4	
WJF	90071711	74.0		56.0		9.5		5.5	
SBD	90071711	69.0		63.0		-0.0		-0.0	
SDB	90071711	67.0		53.0		8.0		0.0	
LAX	90071712	68.0	0.3	64.0	-2.0	6.6	-4.4	-2.4	2.8
NZJ	90071712	68.0	-0.3	62.0	2.0	3.0	5.3	0.5	-3.5
RIV	90071712	69.0		64.0		2.0		-0.3	
BUR	90071712	68.0		64.0		-0.0		-0.0	
ONT	90071712	69.0		59.0		-0.0		-0.0	
MWS	90071712	67.0		47.0		-0.0		-0.0	
SBD	90071712	69.0		63.0		-0.0		-0.0	
VCV	90071712	71.0		55.0		-0.3		2.0	
WJF	90071712	73.0		55.0		7.8		4.5	
SDB	90071712	68.0		52.0		5.6		-2.1	
EDW	90071712	72.0		61.0		2.5		4.3	
MWS	90071713	67.0		47.0		-0.0		-0.0	
LGB	90071713	69.0	1.1	65.0	-1.7	4.7	-4.7	-1.7	1.7
LAX	90071713	68.0	0.3	64.0	-2.0	8.0	-8.0	0.0	0.0
NZJ	90071713	68.0	2.7	62.0	1.6	-0.0	0.4	-0.0	-0.2
RIV	90071713	68.0		65.0		2.6		-1.5	
VCV	90071713	70.0		55.0		-0.0		-0.0	
EDW	90071713	73.0		62.0		5.4		4.5	
BUR	90071713	67.0	0.2	65.0	-3.1	-0.0	1.1	-0.0	-0.1
ONT	90071713	70.0		58.0		-0.0		-0.0	
WJF	90071713	73.0		55.0		9.5		5.5	
SBD	90071713	69.0		62.0		-0.0		-0.0	
SNA	90071713	71.0	-2.7	64.0	-1.7	-0.0	0.8	-0.0	-0.3
VNY	90071713	67.0	0.1	63.0	1.0	-0.0	0.8	-0.0	0.0
CRQ	90071713					-0.0	6.8	-0.0	-1.0
SDB	90071713	68.0		52.0		5.9		1.0	
MWS	90071714	67.0	1.4	47.0	15.9	-0.0	0.1	-0.0	-0.0
LGB	90071714	70.0	-1.7	65.0	-3.5	0.0	2.3	-5.0	4.9
LAX	90071714	69.0	-0.9	64.0	-0.7	8.0	-5.2	0.0	-1.8
NZJ	90071714	68.0	2.4	63.0	0.4	2.8	-2.6	-1.0	1.0
RIV	90071714	70.0	-1.0	66.0	-4.0	0.2	-0.4	-1.0	1.2
SBD	90071714	69.0		63.0		-0.0		-0.0	

VCV	90071714	72.0		55.0		-1.9		2.3	
BUR	90071714	67.0	1.1	65.0	-2.7	-0.0	1.4	-0.0	-0.1
CNO	90071714					-0.0	-1.1	-0.0	1.1
CRQ	90071714					-0.0	6.8	-0.0	-1.0
EMT	90071714					-0.0	0.1	-0.0	-0.0
FUL	90071714	68.0	1.1	62.0	-1.0	3.5	-2.7	2.0	-3.3
HHR	90071714					3.2	2.0	-3 8	3.8
ONT	90071714	69.0	-0.3	59.0	1.2	-2.3	2.5	1.9	-1.9
PMD	90071714					6.4	-1.3	7.7	-5.0
RAL	90071714					-0.0	-0.2	-0.0	0.2
SNA	90071714	71.0	-2.7	64.0	-1.1	-0.0	2.0	-0.0	-0.7
VNY	90071714	68.0	-0.6	63.0	1.0	-0.0	1.4	-0.0	0.2
WJF	90071714	74.0	-1.0	55.0	2.5	5.6	0.0	2.1	4.4
EDW	90071714	73.0		61.0		3.0	3.4	5.2	2.5
NUC	90071714								
SMO	90071714	68.0	0.5	64.0	-0.7	4.3	-0.3	2.5	-3.4
TOA	90071714	68.0	1.0			-0.0	3.3	-0.0	-1.9
SDB	90071714	73.0		52.0		3.9		-0.7	
LGB	90071715	70.0	-1.5	65.0	-1.9	0.0	2.1	-5.0	4.7
NZJ	90071715	68.0	2.4	63.0	0.4	2.8	-2.6	-1.0	1.0
RIV	90071715	70.0	-1.0	66.0	-4.0	0.2	-0.4	-1.0	1.2
SBD	90071715	69.0		63.0		-0.0		-0.0	
VCV	90071715	72.0		55.0		-1.9		2.3	
BUR	90071715	67.0	1.3	65.0	-1.6	-0.0	1.2	-0.0	-0.3
CNO	90071715					-0.0	-1.1	-0.0	1.2
CRQ	90071715					-0.0	2.4	-0.0	-2.1
EMT	90071715					-0.0	0.0	-0.0	-3.7
FUL	90071715	68.0	1.6	62.0	1.8	3.5	-2.7	2.0	-3.6
HHR	90071715					3.2	-0.1	-3.8	2.3
ONT	90071715	69.0	0.1	59.0	4.6	-2.3	2.5	1.9	-1.9
PMD	90071715					6.4	-1.3	7.7	-5.0
RAL	90071715					-0.C	-0.2	-0.0	0.2
SNA	90071715	71.0	-2.7	64.0	-1.1	-0.0	2.0	-0.0	-0.7
VNY	90071715	68.0	-0.5	63.0	1.7	-0.0	1.2	-0.0	-0.0
WJF	90071715	74.0	-1.0	55.0	2.5	5.6	0.0	2.1	4.4
EDW	90071715	73.0		61.0		3.0	3.4	5.2	2.5
NUC	90071715								
SMO	90071715	68.0	1.1	64.0	0.0	4.3	-1.8	2.5	-4.5
TOA	90071715	68.0	1.4			-0.0	2.5	-0.0	-2.5
SDB	90071715	73.0		52.0		3.9		-0.7	
LAX	90071715	70.0	-1.9	64.0	0.0	4.3	-1.5	-2.5	0.6
LGB	90071716	70.0	-1.5	65.0	-1.9	0.0	2.1	-5.0	4.7
NZJ	90071716	68.0	2.4	63.0	0.4	2.8	-2.6	-1.0	1.0
RIV	90071716	70.0	-1.0	66.0	-4.0	0.2	-0.4	-1.0	1.2
SBD	90071716	69.0		63.0		-0.0		-0.0	
VCV	90071716	72.0		55.0		-1.9		2.3	
BUR	90071716	67.0	1.3	65.0	-1.6	-0.0	1.2	-0.0	-0.3

CNO	90071716					-0.0	-1.1	-0.0	1.2
CRQ	90071716					-0.0	2.4	-0.0	-2.1
EMT	90071716					-0.0	0.0	-0.0	-3.7
FUL	90071716	68.0	1.6	62.0	1.8	3.5	-2.7	2.0	-3.6
HHR	90071716					3.2	-0.1	-3.8	2.3
ONT	90071716	69.0	0.1	59.0	4.6	-2.3	2.5	1.9	-1.9
PMD	90071716					6.4	-1.3	7.7	-5.0
RAL	90071716					-0.0	-0.2	-0.0	0.2
SNA	90071716	71.0	-2.7	64.0	-1.1	-0.0	2.0	-0.0	-0.7
VNY	90071716	68.0	-0.5	63.0	1.7	-0.0	1.2	-0.0	-0.0
WJF	90071716	74.0	-1.0	55.0	2.5	5.6	0.0	2.1	4.4
EDW	90071716	73.0		61.0		3.0	3.4	5.2	2.5
NUC	90071716								
SMO	90071716	68.0	1.1	64.0	0.0	4.3	-1.8	2.5	-4.5
TOA	90071716	68.0	1.4			-0.0	2.5	-0.0	-2.5
SDB	90071716	73.0		52.0		3.9		-0.7	
LAX	90071716	70.0	-1.9	64.0	0.0	4.3	-1.5	-2.5	0.6
LAX	90071717	70.0		64.0		4.3		-2.5	
WJF	90071722	96.0		54.0		12.9		15.3	
SDB	90071722	86.0		55.0		-6.4		7.7	
LGB	90071723	84.0	-4.1	65.0	-1.0	10.3	-1.6	-3.8	6.1
NZJ	90071723	83.0	0.8	62.0	2.6	9.0	-0.7	0.0	7.9
LAX	90071723	74.0	3.8	64.0	0.7	15.8	-6.2	2.8	-1.3
RIV	90071723	94.0	0.3	64.0	-0.8	13.2	-1.3	-4.8	2.8
SBD	90071723	94.0		64.0		6.9		1.2	
VCV	90071723	98.0		46.0		4.7		-1.7	
BUR	90071723	87.0	-3.3	60.0	0.3	-2.7	4.6	7.5	-5.0
CNO	90071723					12.2	-2.4	4.4	-6.6
CRQ	90071723					7.5	5.4	-2.7	2.4
EMT	90071723					2.1	4.4	5.6	-7.2
FUL	90071723	87.0	-4.7	64.0	0.2	3.4	6.0	9.4	-8.3
HHR	90071723					10.0	3.0	0.0	1.9
ONT	90071723	95.0	-6.1	61.0	2.8	9.4	1.6	-3.4	5.5
PMD	90071723					17.3	-4.4	10.0	3.4
POC	90071723					7.9	0.8	-1.4	2.8
RAL	90071723					16.0	-5.6	-5.8	5.7
SMO	90071723	75.0	3.7	66.0	-3.5	10.7	-1.4	9.0	-7.1
SNA	90071723	82.0	2.0	65.0	-2.3	7.5	1.1	13.0	-12.2
TOA	90071723	75.0	4.8			13.0	-2.9	-7.5	9.3
VNY	90071723	88.0	-4.6	58.0	3.4	-4.7	7.0	1.7	4.7
EDW	90071723	104.0		59.0		13.2	4.2	4.8	5.2
WJF	90071723	96.0	0.2	54.0	3.4	12.9	1.7	15.3	-6.3
SDB	90071723	84.0		55.0		-4.5		7.8	
LGB	90071800	84.0	-4.9	65.0	-2.4	10.3	-2.1	-3.8	6.7
LAX	90071800	74.0	3.7	64.0	1.1	12.2	-3.8	4.4	-0.8
NZJ	90071800	81.0	1.8	62.0	2.2	7.5	-1.2	2.7	6.2
RIV	90071800	92.0	1.5	59.0	3.2	11.8	-0.5	-2.1	2.4

VCV	90071800	97.0		55.0		2.4		13.8	
BUR	90071800	86.0	-2.6	61.0	1.1	-2.7	3.9	7.5	-4.9
CNO	90071800					14.1	-4.3	5.1	-4.4
CRQ	90071800					8.0	3.1	0.0	1.5
EMT	90071800					5.1	-2.2	6.1	-3.1
FUL	90071800	85.0	-3.6	62.0	0.8	8.5	-0.3	3.1	-0.4
HHR	90071800					9.4	1.0	3.4	-0.2
ONT	90071800	95.0	-9.4	60.0	0.7	10.0	1.7	0.0	3.3
PMD	90071800					12.9	3.4	15.3	-2.3
POC	90071800					8.0	0.7	0.0	2.9
RAL	90071800					15.0	-4.2	0.0	1.2
SMO	90071800	75.0	3.5	67.0	-4.2	7.7	-0.0	9.2	-5.9
SNA	90071800	81.0	1.4	65.0	-2.7	2.6	6.1	14.8	-13.2
TOA	90071800	75.0	4.5			11.3	-2.4	-4.1	7.2
VNY	90071800	88.0	-5.5	61.0	1.1	-4.9	6.5	0.9	5.9
WJF	90071800	95.0	-1.6	54.0	2.9	16.9	-4.1	14.1	-2.1
EDW	90071800	100.0		60.0		13.9	-1.0	8.0	7.3
MWS	90071800	79.0	4.8	56.0	6.6	2.6	2.8	3.1	2.8
SBD	90071800	93.0		63.0		5.9		-1.0	
SDB	90071800	83.0		52.0		10.4		-6.0	
WJF	90071801	95.0	-4.6	54.0	1.9	16.9	-3.4	14.1	-5.2
MWS	90071801	79.0	3.4	56.0	7.2	2.6	-1.0	3.1	2.6
LGB	90071801	81.0	-3.0	63.0	0.1	9.4	-1.2	-3.4	4.4
LAX	90071801	72.0	4.6	65.0	0.2	12.2	-3.5	4.4	-4.2
NZJ	90071801	79.0	2.6	63.0	0.6	7.9	0.7	1.4	3.8
VCV	90071801	94.0		56.0		0.0		13.0	
BUR	90071801	86.0	-3.6	62.0	1.4	-3.4	5.3	9.4	-6.4
CNO	90071801					16.0	-4.0	5.8	-3.0
CRQ	90071801					8.0	3.1	0.0	-0.9
EMT	90071801					1.0	1.9	5.9	-2.9
FUL	90071801	84.0	-4.3	63.0	-0.8	6.1	2.4	3.5	-2.0
HHR	90071801					10.0	0.3	0.0	2.3
ONT	90071801	93.0	-8.5	61.0	-0.2	14.1	-1.3	5.1	-2.0
PMD	90071801					13.8	2.5	11.6	1.4
POC	90071801					10.0	-0.5	0.0	4.1
RAL	90071801					14.8	-2.9	-2.6	4.7
SMO	90071801	74.0	3.1	67.0	-3.3	7.5	0.2	2.7	0.2
SNA	90071801	80.0	0.5	64.0	-1.1	6.4	2.4	7.7	-6.5
TOA	90071801	74.0	3.6			12.1	-3.4	-7.0	8.5
VNY	90071801	87.0	-4.9	63.0	-0.1	-3.2	4.3	3.8	2.7
EDW	90071801	97.0		59.0		13.9	-0.1	8.0	3.6
RIV	90071801	90.0	2.3	58.0	4.5	9.4	2.9	-3.4	3.2
SBD	90071801	92.0		63.0		6.9		-1.2	
SDB	90071801	80.0		51.0		10.7		-9.0	
MWS	90071802	79.0	0.6	56.0	7.4	2.6	0.7	3.1	1.9
LGB	90071802	78.0	-2.5	65.0	-2.7	10.8	-2.7	-1.9	3.3
LAX	90071802	71.0	2.9	65.0	-0.0	11.8	-2.9	2.1	-1.2

NZJ	90071802	77.0	2.4	62.0	1.4	7.5	1.0	2.7	1.6
VCV	90071802	93.0		50.0		11.8		2.1	
EDW	90071802	93.0		59.0		13.2	0.6	4.8	6.8
BUR	90071802	81.0	-1.2	65.0	-1.1	-2.7	5.2	7.5	-4.8
CNO	90071802					7.7	3.3	9.2	-10.9
CRQ	90071802					5.0	6.3	0.0	-0.4
EMT	90071802					3.0	-0.1	5.2	-2.2
FUL	90071802	82.0	-4.5	61.0	1.7	6.9	1.4	5.8	-4.4
HHR	90071802					10.0	0.1	0.0	1.3
ONT	90071802	90.0	-7.3	61.0	0.4	12.8	-4.8	-2.3	6.5
POC	90071802					7.5	0.5	-2.7	5.3
RAL	90071802					14.1	-5.7	-5.1	6.5
SMO	90071802	72.0	2.9	66.0	-1.6	8.7	-0.9	5.0	-3.2
SNA	90071802	78.0	0.2	64.0	-1.8	7.7	0.5	6.4	-4.2
TOA	90071802	70.0	5.6			10.4	-1.2	-6.0	7.4
VNY	90071802	84.0	-5.8	64.0	0.8	-2.6	4.2	3.1	2.5
RIV	90071802	88.0	1.3	62.0	2.0	6.1	5.1	-3.5	1.7
SBD	90071802	89.0		65.0		7.9		-1.4	
WJF	90071802	89.0	-2.2	53.0	2.1	14.6	-2.9	12.2	-4.3
SDB	90071802	77.0		49.0		4.5		-5.4	
PMD	90071802					12.3	2.0	10.3	0.6
LGB	90071803	73.0	-0.0	66.0	-3.0	7.7	-0.8	-6.4	9.6
LAX	90071803	70.0	1.5	64.0	0.8	10.3	-2.9	3.8	-0.3
EDW	90071803	89.0		59.0		9.2	2.1	7.7	-1.2
BUR	90071803	78.0	-0.7	65.0	-0.7	-2.1	4.8	5.6	-3.9
CNO	90071803					6.4	4.6	7.7	-5.5
CRQ	90071803					5.0	3.6	0.0	1.1
EMT	90071803					2.1	3.8	5.6	-7.9
FUL	90071803	78.0	-4.3	61.0	3.5	6.9	-0.2	4.0	-2.8
HHR	90071803					9.4	-1.0	3.4	-0.5
ONT	90071803	85.0	-5.0	60.0	3.3	14.1	-7.3	5.1	-1.6
POC	90071803					7.9	0.7	-1.4	5.7
RAL	90071803					10.4	-2.6	-6.0	8.7
SMO	90071803	70.0	2.9	65.0	-0.8	4.0	3.1	6.9	-4.0
SNA	90071803	75.0	-0.2	66.0	-4.4	2.7	3.6	7.5	-7.0
TOA	90071803	69.0	3.6			8.0	-0.3	0.0	1.9
VNY	90071803	81.0	-5.4	64.0	0.9	-0.0	1.0	-0.0	5.4
NZJ	90071803	74.0	2.0	61.0	3.9	5.0	0.3	0.0	4.8
RIV	90071803	84.0	1.0	64.0	-0.3	6.1	2.1	-3.5	2.6
PMD	90071803					11.3	0.4	6.5	3.3
SBD	90071803	85.0		65.0		3.9		0.7	
VCV	90071803	88.0		53.0		7.8		4.5	
WJF	90071803	85.0	-1.4	55.0	-0.3	12.3	-1.9	10.3	-5.1
SDB	90071803	75.0		48.0		5.0		-8.7	
CNO	90071804					6.4	0.9	7.7	-6.2
EMT	90071804					2.1	3.8	5.6	-7.9
HHR	90071804					9.4	-0.4	3.4	-0.2

POC 90071804					7.9	-1.7	-1.4	5.3
RAL 90071804					10.4	-3.3	-6.0	8.4
TOA 90071804	69.0	2.2			8.0	0.2	0.0	2.4
LGB 90071804	72.0	-0.6	65.0	-1.4	9.4	-2.7	-3.4	6.1
LAX 90071804	69.0	1.4	64.0	0.9	11.3	-3.9	4.1	-0.6
RIV 90071804	81.0	1.0	64.0	-0.5	9.4	-2.0	-3.4	2.2
VCV 90071804	81.0		56.0		-0.3		2.0	
EDW 90071804	86.0		60.0		8.7	2.1	5.0	4.0
BUR 90071804	75.0	-0.0	66.0	-1.8	-3.8	6.7	3.2	-1.3
CRQ 90071804					-0.0	9.2	-0.0	1.9
FUL 90071804	75.0	-2.8	62.0	2.3	5.6	1.3	2.1	-0.2
ONT 90071804	82.0	-4.9	59.0	4.9	6.9	0.0	4.0	-0.5
PMD 90071804					10.7	-2.1	9.0	-4.0
SMO 90071804	69.0	2.4	65.0	-0.7	4.0	3.4	6.9	-4.1
SNA 90071804	73.0	-0.7	66.0	-3.1	2.4	5.2	6.6	-5.3
VNY 90071804	78.0	-4.8	64.0	1.6	-0.0	-0.0	-0.0	3.9
NZJ 90071804	71.0	2.9	63.0	1.9	7.9	-3.3	1.4	2.8
SBD 90071804	82.0		65.0		4.0		0.0	
WJF 90071804								
SDB 90071804	73.0		50.0		0.8		0.6	
CNO 90071805					6.4	2.7	7.7	-7.5
EMT 90071805					2.1	3.6	5.6	-7.3
HHR 90071805					9.4	-1.5	3.4	0.7
POC 90071805					7.9	-0.6	-1.4	4.3
RAL 90071805					10.4	-3.9	-6.0	8.2
TOA 90071805	69.0	2.0			8.0	-0.6	0.0	2.6
CRQ 90071805					-0.0	8.2	-0.0	2.1
FUL 90071805	75.0	-3.2	62.0	3.0	5.6	0.6	2.1	-1.1
SMO 90071805	69.0	2.2	65.0	-1.3	4.0	2.9	6.9	-3.3
LGB 90071805	71.0	0.5	66.0	-2.4	6.9	-0.4	-4.0	6.5
LAX 90071805	70.0	0.0	63.0	2.0	9.5	-2.1	5.5	-2.0
NZJ 90071805	71.0	2.7	64.0	1.6	1.9	3.9	-0.7	2.4
RIV 90071805	78.0	1.5	64.0	-1.3	5.6	1.5	-2.1	0.8
VCV 90071805	79.0		56.0		0.9		4.9	
BUR 90071805	73.0	0.1	65.0	-0.2	-0.9	3.5	4.9	-2.9
ONT 90071805	81.0	-5.3	59.0	4.9	10.8	-4.2	1.9	1.5
PMD 90071805					9.0	-2.9	10.7	-7.2
SNA 90071805	73.0	-0.9	67.0	-3.4	4.3	-0.0	2.5	-2.5
VNY 90071805	75.0	-3.1	65.0	-0.2	-0.0	1.7	-0.0	5.1
EDW 90071805	84.0		58.0		6.1	2.9	3.5	7.2
SBD 90071805	79.0		64.0		1.9		0.7	
WJF 90071805								
SDB 90071805	73.0		47.0		2.3		-1.9	
CRQ 90071806					-0.0	7.1	-0.0	1.8
FUL 90071806	75.0	-3.1	62.0	-0.2	5.6	-0.3	2.1	-3.0
SMO 90071806	69.0	2.3	65.0	-1.9	4.0	1.2	6.9	-4.8
SNA 90071806	73.0	-1.4	67.0	-2.9	4.3	1.1	2.5	-2.1

VNY	90071806	75.0	-3.7	65.0	-0.9	-0.0	-0.3	-0.0	4.3
EDW	90071806	84.0		58.0		6.1	1.6	3.5	2.9
LGB	90071806	71.0	1.5	65.0	-2.9	6.1	-1.1	-3.5	5.6
LAX	90071806	70.0	0.3	63.0	1.1	8.5	-5.1	3.1	1.3
RIV	90071806	77.0		63.0		1.9		-0.7	
SBD	90071806	77.0		63.0		0.9		0.3	
VCV	90071806	77.0		55.0		0.0		4.0	
BUR	90071806	72.0	1.2	65.0	-1.3	-2.5	4.3	4.3	-3.3
ONT	90071806	79.0		58.0		9.8		-1.7	
PMD	90071806					7.7	-1.6	6.4	-2.9
MWS	90071806	72.0		48.0		2.5		-4.3	
NZJ	90071806	70.0	3.6	65.0	0.5	4.9	0.1	0.9	0.8
WJF	90071806								
SDB	90071806	72.0		47.0		1.7		-1.0	
SNA	90071807	73.0	-2.3	67.0	-2.5	4.3	-3.3	2.5	-3.0
VNY	90071807	75.0	-4.0	65.0	-1.0	-0.0	0.3	-0.0	0.2
EDW	90071807	84.0		58.0		6.1	1.6	3.5	2.9
MWS	90071807	72.0		48.0		2.5		-4.3	
LGB	90071807	71.0	1.1	64.0	2.3	4.3	-1.5	-2.5	4.1
LAX	90071807	70.0	0.3	64.0	1.0	1.4	-1.4	3.8	-3.8
RIV	90071807	75.0		63.0		2.6		-1.5	
SBD	90071807	77.0		61.0		-0.0		-0.0	
VCV	90071807	77.0		55.0		-0.5		3.0	
BUR	90071807	71.0	3.1	65.0	-1.5	-0.0	0.5	-0.0	-0.1
ONT	90071807	78.0		60.0		4.7		-1.7	
PMD	90071807					1.7	4.3	9.8	-6.3
NZJ	90071807	70.0	3.2	65.0	1.1	-0.0	4.4	-0.0	1.7
WJF	90071807								
SDB	90071807	71.0		49.0		4.9		-0.9	
MWS	90071808	72.0		48.0		2.5		-4.3	
LGB	90071808	71.0	-0.7	64.0	1.0	4.3	-4.3	-2.5	2.5
LAX	90071808	70.0	0.3	64.0	1.0	-0.9	0.9	4.9	-4.9
RIV	90071808	74.0		63.0		2.0		0.0	
SBD	90071808	75.0		63.0		-0.0		-0.0	
VCV	90071808	76.0		54.0		-0.3		0.9	
BUR	90071808	70.0		65.0		-0.0		-0.0	
ONT	90071808	75.0		59.0		2.0		3.5	
PMD	90071808					1.7		9.8	
NZJ	90071808	70.0	0.4	65.0	-1.0	-0.0	2.9	-0.0	-0.1
WJF	90071808								
SDB	90071808	71.0		49.0		4.9		-0.9	
LGB	90071809	71.0	-0.7	64.0	-2.0	4.3	-4.3	-2.5	2.5
PMD	90071809					1.7		9.8	
LAX	90071809	69.0	1.3	64.0	-2.0	2.6	-2.6	3.1	-3.1
RIV	90071809	73.0		63.0		1.5		-1.3	
SBD	90071809	73.0		63.0		-0.0		-0.0	
VCV	90071809	75.0		53.0		-0.2		1.0	

BUR	90071809	70.0		65.0		-0.0		-0.0	
ONT	90071809	75.0		60.0		5.9		-1.0	
NZJ	90071809	70.0	0.1	62.0	2.0	-0.0	4.0	-0.0	-0.8
WJF	90071809								
SDB	90071809	69.0		53.0		4.5		-5.4	
LAX	90071810	69.0	1.3	64.0	-1.0	5.2	[illegible]	3.0	-3.0
NZJ	90071810	70.0	-1.3	63.0	1.0	-0.0	[illegible]	-0.0	3.7
RIV	90071810	72.0		63.0		-0.0		-0.0	
SBD	90071810	73.0		63.0		-0.0		-0.0	
VCV	90071810	74.0		52.0		-0.0		-0.0	
BUR	90071810	70.0		65.0		-0.0		-0.0	
ONT	90071810	74.0		60.0		-0.0		-0.0	
WJF	90071810								
SDB	90071810	69.0		52.0		7.1		-8.4	
LAX	90071811	69.0	0.3	65.0	-2.0	5.2	-5.2	3.0	-3.0
RIV	90071811	72.0		63.0		-0.0		-0.0	
SBD	90071811	71.0		63.0		-0.0		-0.0	
VCV	90071811	73.0		52.0		-3.1		2.6	
BUR	90071811	70.0		65.0		-0.0		-0.0	
ONT	90071811	72.0		59.0		-0.0		-0.0	
NZJ	90071811	69.0	-0.3	63.0	2.0	-0.0	6.5	-0.0	3.7
WJF	90071811	77.0		52.0		10.8		1.9	
SDB	90071811	69.0		50.0		6.1		-5.1	
LAX	90071812	69.0	0.3	65.0	-2.0	5.2	-5.2	3.0	-3.0
RIV	90071812	72.0		63.0		-0.0		-0.0	
SBD	90071812	71.0		63.0		-0.0		-0.0	
VCV	90071812	73.0		52.0		-3.1		2.6	
BUR	90071812	70.0		65.0		-0.0		-0.0	
ONT	90071812	72.0		59.0		-0.0		-0.0	
NZJ	90071812	69.0	-0.3	63.0	2.0	-0.0	6.5	-0.0	3.7
WJF	90071812	77.0		52.0		10.8		1.9	
SDB	90071812	69.0		50.0		6.1		-5.1	
LAX	90071813	69.0	0.3	65.0	-2.0	5.2	-5.2	3.0	-3.0
RIV	90071813	72.0		63.0		-0.0		-0.0	
SBD	90071813	71.0		63.0		-0.0		-0.0	
VCV	90071813	73.0		52.0		-3.1		2.6	
BUR	90071813	70.0		65.0		-0.0		-0.0	
ONT	90071813	72.0		59.0		-0.0		-0.0	
NZJ	90071813	69.0	-0.3	63.0	2.0	-0.0	6.5	-0.0	3.7
WJF	90071813	77.0		52.0		10.8		1.9	
SDB	90071813	69.0		50.0		6.1		-5.1	
Obs Mean :			76.6		60.8		4.5		2.5
Error Mean :			-0.3		0.4		0.4		0.3
Abs Error Mean:			2.0		1.9		2.9		3.5

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*           Station Summary            *
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Station : SDB
   Obs Mean      :   72.8         52.8          4.1          0.9
   Error Mean    : -999.9       -999.9       -999.9       -999.9
   Abs Error Mean: -999.9       -999.9       -999.9       -999.9

Station : MWS
   Obs Mean      :   72.2         51.2          1.3          1.9
   Error Mean    :    3.9          9.6          1.4          1.3
   Abs Error Mean:    3.9          9.6          1.7          2.1

Station : WJF
   Obs Mean      :   82.6         54.1          9.7          9.3
   Error Mean    :   -1.6          3.0         -0.4         -2.3
   Abs Error Mean:    2.0          3.1          1.6          4.2

Station : SMO
   Obs Mean      :   72.6         65.0          6.3          6.1
   Error Mean    :    1.5         -1.6         -0.9         -3.4
   Abs Error Mean:    1.7          1.7          2.2          3.7

Station : ONT
   Obs Mean      :   79.8         59.8          6.4          1.6
   Error Mean    :   -5.3          2.4         -2.0         -0.2
   Abs Error Mean:    5.3          2.4          3.2          2.0

Station : EDW
   Obs Mean      :   86.5         59.1          7.0          5.3
   Error Mean    : -999.9       -999.9          1.6          4.1
   Abs Error Mean: -999.9       -999.9          2.7          4.8

Station : VNY
   Obs Mean      :   77.7         62.8         -1.7          2.0
   Error Mean    :   -2.6          1.1          2.6          2.4
   Abs Error Mean:    2.7          1.2          3.2          2.9

Station : TOA
   Obs Mean      :   72.2       -999.9          4.9         -2.2
   Error Mean    :    2.2       -999.9          1.0          4.8
   Abs Error Mean:    2.3       -999.9          4.0          5.4

Station : SNA
   Obs Mean      :   74.8         64.8          3.1          6.6
   Error Mean    :   -0.2         -2.0          1.0         -5.4
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Abs Error Mean:	1.4	2.0	2.5	5.5
Station : RAL				
Obs Mean :	-999.9	-999.9	10.3	-3.2
Error Mean :	-999.9	-999.9	-3.5	4.4
Abs Error Mean:	-999.9	-999.9	3.7	4.4
Station : POC				
Obs Mean :	-999.9	-999.9	6.6	-0.2
Error Mean :	-999.9	-999.9	0.4	3.4
Abs Error Mean:	-999.9	-999.9	1.9	3.5
Station : PMD				
Obs Mean :	-999.9	-999.9	8.8	8.9
Error Mean :	-999.9	-999.9	-0.9	-0.4
Abs Error Mean:	-999.9	-999.9	2.3	3.4
Station : HHR				
Obs Mean :	-999.9	-999.9	7.1	1.0
Error Mean :	-999.9	-999.9	-0.2	2.0
Abs Error Mean:	-999.9	-999.9	1.8	2.2
Station : FUL				
Obs Mean :	76.5	62.7	2.9	4.8
Error Mean :	-1.5	0.4	2.2	-2.7
Abs Error Mean:	1.9	1.1	3.1	3.0
Station : EMT				
Obs Mean :	-999.9	-999.9	2.4	4.3
Error Mean :	-999.9	-999.9	0.6	-3.4
Abs Error Mean:	-999.9	-999.9	1.8	3.9
Station : CRQ				
Obs Mean :	-999.9	-999.9	4.0	0.6
Error Mean :	-999.9	-999.9	2.9	1.2
Abs Error Mean:	-999.9	-999.9	5.3	2.4
Station : CNO				
Obs Mean :	-999.9	-999.9	7.6	3.8
Error Mean :	-999.9	-999.9	-0.0	-2.6
Abs Error Mean:	-999.9	-999.9	2.6	3.4
Station : BUR				
Obs Mean :	74.7	64.2	-1.4	3.6
Error Mean :	-0.8	-1.1	3.3	-2.6
Abs Error Mean:	1.5	1.4	3.8	2.7

Station : VCV				
Obs Mean :	80.8	54.1	0.2	3.7
Error Mean :	-999.9	-999.9	-999.9	-999.9
Abs Error Mean:	-999.9	-999.9	-999.9	-999.9

Station : SBD				
Obs Mean :	79.0	63.8	2.5	0.1
Error Mean :	-999.9	-999.9	-999.9	-999.9
Abs Error Mean:	-999.9	-999.9	-999.9	-999.9

Station : RIV				
Obs Mean :	78.7	63.8	4.3	-1.8
Error Mean :	0.7	-0.4	1.5	2.2
Abs Error Mean:	1.2	1.7	2.2	2.2

Station : NZJ				
Obs Mean :	72.8	62.7	2.8	0.6
Error Mean :	1.0	1.5	2.1	3.0
Abs Error Mean:	1.6	1.6	3.5	3.4

Station : NUC				
Obs Mean :	-999.9	-999.9	-999.9	-999.9
Error Mean :	-999.9	-999.9	-999.9	-999.9
Abs Error Mean:	-999.9	-999.9	-999.9	-999.9

Station : LGB				
Obs Mean :	74.0	64.5	4.6	-0.5
Error Mean :	-0.7	-1.4	-0.7	2.5
Abs Error Mean:	1.5	1.6	2.8	5.0

Station : LAX				
Obs Mean :	71.0	63.9	7.4	2.8
Error Mean :	1.0	-0.1	-3.6	-1.6
Abs Error Mean:	1.4	1.1	4.0	2.0